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ABSTRACT

A study assessed the training effectiveness of instructional materials designed in accordance with three format models for (1) recalling facts about equipment, (2) applying rules and regulations, and (3) classifying objects and signals. Three types of self-paced instructional materials were compared: learning aids, programmed instruction, and traditional text. The evaluation was conducted at the Quartermaster School, Service School Command, Naval Training Center, Orlando, Florida. The materials provided information and skill development related to navigational lights, one part of the International Rules of the Road. Results showed that training conducted with materials designed according to the learning aids format produces better student performance than training with programmed or traditional instructional materials. Students using learning aids spent more time studying. Effective techniques common to the format models were division of material into small, easily learned blocks; use of illustrations; distributed practice through exercises, self-tests, and directions for remediation at appropriate points; and immediate feedback on student responses. (Appendixes include data tables and excerpts from instructional materials.) (YLB)

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Technical Report 138

EFFECTIVENESS OF JOB TRAINING MATERIALS BASED ON THREE FORMAT MODELS: A FIELD EVALUATION

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Training Analysis and Evaluation Group

January 1983

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The study evaluated instructional materials designed according to three format models each responsive to a comprehensive set of learning principles. The format models were from the larger set of format models in the Navy's Procedures for Instructional Systems Development (NAVEDTRA 110A). The selected models were designed to support the development of materials to teach (1) recalling facts about equipment, (2) applying rules and regulations, and (3) classifying objects and signals. Materials based on these format

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models were experimentally compared with Programmed Instruction and Traditional Text materials. The evaluation was conducted at the Quartermaster School, Service School Command, Naval Training Center, Orlando. The materials taught information and skills related to navigation lights, one part of the International Rules of the Road.

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Student assistants at TAEG, Terry L. Chissoe and William Marek, helped to assemble the programmed instruction modules and assembled the classroom materials and tests. Mr. Marek also distributed the materials and administered the tests in the QM classrooms. Their help is greatly appreciated.

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SECTION I

INTRODUCTION

The development, revision, and publication of instructional materials to support over 4,000 courses is a major effort required of the Chief of Naval Education and Training (CNET). Because of the impact of instructional materials on the time to complete training and subsequent job performance, CNET is continuously attempting to improve the effectiveness and efficiency of these materials. This effort is labor intensive and time consuming. Ways are needed to systematically produce these materials and simultaneously improve their training effectiveness and efficiency.

One way to improve training materials is to ensure that they are organized and used in accordance with applicable learning principles. In recognition of the need for widespread application of this fundamental approach, the CNET tasked the Training Analysis and Evaluation Group (TAEG) to develop learning guidelines for common types of military tasks. The early effort in guideline development resulted in Learning Guidelines and Algorithms for Types of Training Objectives (Aagard and Braby, 1976) which was incorporated into Interservice Procedures for Instructional Systems Development (NAVEDTRA 106A, 1975). However, feedback from instructional developers indicated a need for additional job aids on the use of these guidelines with various kinds of instructional media.

The problem is that the various media (e.g., paper, film, microprocessor) require different formats for presenting material even though learning events in each are similar and are structured according to the principles of the appropriate learning algorithm. Accordingly, CNET tasked TAEG to develop job aids for developing instructional materials appropriate for use with common military tasks.[1] The format models were to be developed for instruction delivered via paper, the most commonly used medium. Five common tasks most frequently taught were selected: performing procedures, recognizing and drawing symbols, recalling facts about equipment, applying rules and regulations, and classifying objects and signals.

The development process involved (1) constructing preliminary conceptual models, (2) validating instruction based on the interim models, (3) revising the interim models, and (4) preparing a handbook on the use of the revised format models. Initial validation efforts involving the format models for symbol learning (Ainsworth, 1979) and procedures learning (Polino and Braby, 1980; Scott, McDaniel, and Braby, 1982) have shown that instructional materials developed following recommended guidelines were more effective than materials being used at that time.

In a parallel effort, instructional materials using learning guidelines for recalling facts about equipment, applying rules and regulations, and classifying objects and signals, were developed and evaluated. This parallel effort is the subject of the present report.

[1]CNET ltr Code N-53 of 24 April 1980.

Early versions of the format models were published in Procedures for Instructional Systems Development (NAVEDTRA 110A, 1981). Revised versions of each format model are contained in the recently published Handbook of Format Models for Designers of Technical Training Materials (Braby, Hamel, and Smode, 1982). The content of the handbook includes all of the essential modifications suggested by the results of related studies including those of the present report.

PURPOSE

This present study assessed the training effectiveness of instructional materials designed in accordance with the format models for (1) recalling facts about equipment, (2) applying rules and regulations, and (3) classifying objects and signals. The models were evaluated in the context of the Quartermaster School, Service School Command, Orlando, and, specifically, for the teaching of navigation lights in the Rules of the Road.

ORGANIZATION OF THE REPORT

In addition to this introduction, the report contains three sections and five appendices. Section II describes the design of the study, the students who served as experimental subjects, the instructional materials, and the evaluation procedures. Section III presents the results of the study in terms of student learning and retention. Section IV contains a discussion of study findings and recommendations regarding the use and further development of the format models. Appendix A contains a summary of the instructor's role in the classroom during the second phase of the study. Appendix B contains the analysis of variance source tables. Appendices C, D, and E present sample pages taken from each type of instructional material tested in the study.

SECTION II

METHOD

The approach employed in evaluating the format models involved an experimental assessment of instructional materials under actual shcoolhouse conditions. Thus, it was necessary for the study procedures to conform to the requirements of the operational environment while exercising experimental control to the extent feasible. The following paragraphs describe the experimental design of the study, subjects, instructional materials, testing procedures, and the procedures followed in the classroom.

EXPERIMENTAL DESIGN

The design was a 2 (student aptitude) x 2 (instructor participation) x 3 (type of instructional material) x 3 (type of task) factorial with repeated measures on type of task. Performance was also examined in terms of differences in the acquisition and in retention of task knowledge. The study variables and their specific levels used are described below.

STUDENT APTITUDE. Student aptitude for learning the material was established through a composite ASVAB (WK+AR) score. The study group median ASVAB score (108) was used to divide the sample into two groups labeled "above average" and "below average" aptitude.

INSTRUCTOR PARTICIPATION. Instructor participation was characterized as being either (1) minimal involvement or (2) active. Initially, the instructors were told to have minimal involvement with the class. In this phase of the study the examiner distributed materials and answered any questions pertaining to procedures. The instructor's primary purpose was military control.

After the tests from this phase were graded, mean percent correct scores were low in all instructional material conditions. A decision was made to systematically replicate the experiment with more active instructor involvement in an attempt to raise performance levels. All instructors were invited to a 1-hour training session to explain the role they were to play in the classroom. The instructors reviewed a handout (appendix A) which described instructor roles specific to individualized instruction, including subject matter expert, motivator, coach, and disciplinarian. Classroom procedures were prescribed in an attempt to standardize the instructors' behavior in the classroom. In this way, instructor participation was added to the experimental design to examine its effect on learning. However, the effect was of secondary interest in the study, and no attempt was made to quantify the variable. Instructor behavior was not systematically measured in the classroom.

TYPE OF INSTRUCTIONAL MATERIAL. Classes were randomly assigned to one of three types of instructional material (Learning Aids, Programmed Instruction, or Traditional Text) with the restriction that there be an attempt to equalize the number of students assigned each type. Because type of instructional material was the major focus of the study, each type is described in greater detail in subsequent paragraphs. A description of the assignment of classes

to the instructional material and instructor conditions is presented in table 1.

TYPE OF LEARNING TASK. All subjects were required to learn three tasks related to Rules of the Road for lighting vessels. The three learning tasks were: recall facts about the system of lights on a vessel, apply rules for lighting vessels, and classify vessels according to their visible light patterns. Each type of instructional material included all three learning tasks.

The first type of task, recalling facts about a system, involves naming the equipment components, describing the functions served by them, and locating the components on the system. The naming, describing, and locating behaviors are basic enabling skills which make it easier for an individual to learn to operate or maintain the system. The second type of task, applying rules, involves identifying situations that are subject to rules, selecting the proper rule, and applying it correctly. Since rules are expressed through words, an understanding of the precise meaning of words in the rule becomes important. The third type of task, classifying, involves assigning an object or signal to a category based on certain identifiable characteristics and then labeling it with the category name. Objects or signals placed in a given category usually are not identical; they merely have a set of similar characteristics. Knowing the essential features which define a category and knowing how to distinguish one category from another according to similar features is the basis for classifying.

A knowledge of the nature of the interaction of type of task with the type of instructional material is particularly important in this study. A significant interaction would indicate that the relative effectiveness of the three types of instructional material depends on the type of task being learned. In the within-subject design used in this study, the possibility of task carry-over effects calls for a conservative interpretation of the effects of individual instructional formats. An optimum design for this purpose would be to assess instructional formats with independent groups of subjects. However, resource restrictions precluded this option.

SUBJECTS

Initially, 201 enlisted Navy and Coast Guard students in nine consecutive classes in the Quartermaster (QM) School of the Service School Command, Orlando, participated in the study. Seventeen Coast Guard students were eliminated from the sample because of previous exposure to the contents of the instructional materials. Four students from the Job-Oriented Basic Skills (JOBS) program were also eliminated because this program allows students that do not meet minimum standards to enter the programs and receive special remediation. Thus, 180 students comprised the study sample.

The students varied in academic ability, as measured by the Armed Services Vocational Aptitude Battery (ASVAB). A composite score derived from two subtests of the ASVAB, Word Knowledge (WK) and Arithmetic Reasoning (AR), is normally used to screen applicants for the QM school. The cutoff for entry into QM school is 98. Composite scores (WK+AR) of the students in the study ranged from 91 to 129. Fifteen students in the group had received

waivers. A score of 100 is the normalized mean of the distribution for all military recruits and the standard deviation is approximately 15. Table 1 describes the mean ASVAB score and number of students for each class assigned to the various conditions of instructional materials and instructor participation.

INSTRUCTIONAL MATERIALS

Three types of self-paced instructional materials were compared: Learning Aids, Programmed Instruction, and Traditional Text. All contained the same instruction which was derived from Navigation Rules, International-Inland, CG-169 (U.S. Coast Guard, 1977), and students were frequently referred to the CG-169 during the course of the instruction. Only international rules dealing with the lighting of vessels were taught. The three types of instructional materials are described below.

LEARNING AIDS. The learning aids generally conformed to the format models for specialized learning categories presented in the NAVEDTRA 110A. Three modules, each teaching a different learning task, were used to present the information. The format models used to construct the modules were those designed for (1) recalling facts about equipment, (2) applying rules and regulations, and (3) classifying objects and signals.

The format models on which learning aids are based present guidance on how to apply learning principles specific to a learning category. However, all have the following features in common:

- Information is divided into small, easily learned blocks.
- Illustrations present visual information such as the appearance of objects or signals, locations, and spatial relationships.
- Distributed practice is provided through exercises, self-tests, and directions for remediation at appropriate points throughout the module.
- Students are given immediate feedback on their responses within exercises.

From student reports, the modules took an average of 2 hours and 7 minutes to complete, excluding breaktime.

PROGRAMMED INSTRUCTION. This type of instructional material was included in the study in order to compare the effectiveness of Learning Aids with well-constructed programmed instruction (PI) materials. Familiar PI techniques, such as presenting bits of information in frames and using fill-in-the-blank statements to test knowledge, were employed. The three learning tasks were presented in three modules as with the Learning Aids.

From student reports, the modules took an average of 1 hour and 23 minutes to complete, excluding breaktime.

TABLE 1. ASVAB MEANS AND NUMBER OF STUDENTS FOR CLASSES ASSIGNED TO TYPES OF INSTRUCTIONAL MATERIAL AND INSTRUCTOR PARTICIPATION CONDITION

Type of Instructional Material	Instructor Participation	Class ASVAB (WK+AR) Mean	No. of Students
Learning Aids	Minimal Involvement	109.5	24
	Active Role	106.2	20
	Active Role	110.7	26
	Overall	108.9	70
Programmed Instruction	Minimal Involvement	108.6	19
	Minimal Involvement	111.3	15
	Active Role	105.0	14
	Active Role	105.2	13
	Overall	107.7	61
Traditional	Minimal Involvement	108.4	28
	Active Role	106.7	21
	Overall	107.7	49

TRADITIONAL TEXT. The traditional text, Rules of the Road: Lights, was produced by the Service School Command and is Module 9, Topic 2-1 of the Quartermaster A School. It is a programmed text containing both international and inland rules and has been used in the QM school since May 1980. For the study, students were told to ignore all information in the module pertaining to inland rules.

The module contains less information than the Learning Aid and Programmed Instruction modules and so students were given reading assignments from CG-169 to supplement the material in their module. Information for recalling facts about the system of lights, applying rules for lighting vessels, and classifying vessels according to light patterns is contained in one module. The module is called a "programmed text," but unlike optimally designed instruction of this type, it does not expose students to information in the building-block sequence designed to minimize student errors and maximize positive reinforcement.

From student reports, the module took an average of 1 hour and 19 minutes to complete, excluding breaktime.

TESTING PROCEDURES

TESTS. The following paragraphs describe the tests used for assessing student performance with each type of learning task during both the acquisition and retention phases of the study.

Identical tests were used to compare student performance when exposed to Learning Aids, Programmed Instruction, and Traditional materials. A separate test was used for each of the learning tasks: recalling facts about the system of lights, applying rules for lighting vessels, and classifying vessels according to light patterns. For the Learning Aids and Programmed Instruction conditions, the tests corresponded to the three learning task modules. For the Traditional text condition, the tests assessed learning of each type of task separately even though the tasks were combined in one module during instruction. Tests were not equated for difficulty.

Test 1 assessed recall of simple facts about the system of lights. Each of six test items consisted of a picture of a ship and three to four questions. For each question, a very short answer was sufficient. For example, a light on a ship was shown and the student was asked to name the light. Students received one point credit for each correct answer to each part of a test item.

Test 2 assessed application of rules for lighting ships. Each of 12 test items consisted of a description of a vessel's situation and a picture of the vessel minus all lights, along with a two-part question. First, students were required to write the rule that applied, and then were required to draw the position and color of all lights on the vessel. If any part of the drawing was incorrect, the student received no credit for that answer. This criterion was more stringent than that used for the other tests and thus may have contributed to performance differences across the tests.

Test 3 assessed classification of light patterns. Each of 15 test items showed a pattern of lights on a ship as it would appear at night along with two to four questions. On all test items, the student was asked to name the ship's activity defined by the light pattern. Other questions on each test item asked the student to check whether or not the ship was making way, to check the heading of the ship, or other types of descriptive questions. Students received one point credit for each correct answer to each part of a test item.

Two comparable forms of each test (A and B) were developed. One form of the test was used for assessing acquisition and the alternate form was used for testing retention. Assignment of A or B for the two testings was randomized for each student.

The formats of the three tests corresponded more closely to the self-tests in the Learning Aid modules than to the self-tests in the other two sets of instructional materials. For instance, the pictures of ships used in the tests were the same pictures used in the Learning Aid modules. This similarity of the Learning Aid materials and the test materials may have produced a test-taking advantage for students in the Learning Aids condition.

PROCEDURES. An examiner from TAEG distributed materials and tests in all classrooms. The examiner had not participated in the development of the materials nor in the design of the study. He presented a standardized introduction and used standardized procedures in all classrooms.

Before the modules were distributed, classes were warned that all tests on the subject matter would be closed-book. They were also told that the material was an integral part of the course, and that they were responsible for knowing the material for the comprehensive final examination.

Procedures for distributing modules and tests, and retention testing are described below. Learning Aid or Programmed Instruction modules were distributed to students a module at a time. After completing a module, the student received the corresponding test. After turning in a completed test, the student was given the next module and the previous module for review, if requested. The exception to this procedure was the Traditional Text where all three tasks were presented to the student in a single module. In this instance, after completing the single module, the student was given the first test. After turning in this test, the student received the next test, and in this manner completed the three tests sequentially.

Students took each test only once and the examiner did not score tests in the classroom. Progression from one module to the next was based solely on completion of preceding modules, with no specific performance criteria required of students.

One week after a first testing session, the examiner returned to the classroom and delivered retention tests to the instructor to administer. The tests were administered as part of the final examination and were, once again, closed-book. The form of the test (A or B) given a student for the retention phase was the alternate form of the test taken during the acquisition phase.

SECTION III

RESULTS

The effects of instructor interaction, aptitude, type of instructional material, and learning task on the acquisition and retention of International Rules of the Road for lighting vessels are described in this section.

Acquisition scores were analyzed first using a 2(Instructor Participation) x 2(Student Aptitude) x 2(Type of Instructional Material) x 3(Type of Learning Task) design. The analysis of percent correct scores revealed that all of the variables except instructor participation produced significant effects on learning. The effect of instructor participation was not statistically significant ($F = 0.46$). This indicates that the attempt to improve the conditions for learning through instructor intervention was not successful. Retention scores were then analyzed using a 2(Student Aptitude) x 3(Type of Instructional Material) x 3(Type of Learning Task) design and, again, all three variables were found to produce significant effects on learning. The results were the same as in the acquisition phase.

Thus, the pattern of results was similar in both the acquisition and retention phases of the experiment (see table 2). A description of the results for each of the three significant factors follows. Because of the similarity between the acquisition and retention data, statistical values are reported only for the acquisition phase. However, findings are discussed for both phases. The complete statistical results for both phases are reported in the ANOVA source tables in appendix B of this report.

TYPE OF INSTRUCTIONAL MATERIAL

Table 2 shows the mean percent correct items for each type of instructional material for each phase of testing (acquisition and retention).

TABLE 2. PERCENT CORRECT FOR EACH TYPE OF INSTRUCTIONAL MATERIAL, ACQUISITION AND RETENTION PHASES

Testing Phase	Learning Aid	Programmed Instruction	Traditional
Acquisition	57.8	46.7	33.8
Retention	45.9	37.8	30.9

When acquisition scores were analyzed, type of instructional material was shown to significantly affect performance ($F = 44.28$, $p < .001$). The Duncan's Multiple Range test was used to evaluate the relative effectiveness of the different materials. Multiple comparisons revealed that students who received the Learning Aids performed significantly better than those who received

Programmed Instruction, and the Programmed Instruction students performed significantly better than those students who received the traditional text ($p < .01$). However, all means were low. In no condition did the mean performance level approach an acceptable performance criterion.

Similar results were obtained after 7 days, but on the retention test, overall performance levels were somewhat lower.

STUDENT APTITUDE

As expected, when only the aptitude factor was considered, the above average aptitude students performed significantly better than the below average aptitude students ($F = 33.66$, $p < .001$). Table 3 shows the mean percent correct items for the two groups of students in each of the three instructional conditions. Below average aptitude students who received the Learning Aid materials ($\bar{x} = 51.5$) performed the same as the above average aptitude students who received the Programmed Instruction materials ($\bar{x} = 51.7$) and better than the above average students who received the Traditional materials ($\bar{x} = 40.8$).

TABLE 3. PERCENT CORRECT FOR BELOW AVERAGE AND ABOVE AVERAGE STUDENTS BY TYPE OF INSTRUCTIONAL MATERIAL, ACQUISITION PHASE

ASVAB (WK+AR)	Type of Instructional Material		
	Learning Aid	Programmed Instruction	Traditional
Below Average	51.5	42.5	24.5
Above Average	63.8	51.7	40.8

TYPE OF LEARNING TASK

Table 4 presents the mean percent correct items for each learning task for students who received each type of instructional material. Overall, the learning task significantly affected performance ($F = 182.01$, $p < .001$). The mean percent correct for applying rules and regulations (33.3 percent) was lower than the mean percent for recalling facts (64.4 percent) and for classifying objects (44.9 percent).

TABLE 4. PERCENT CORRECT FOR EACH LEARNING TASK (TEST) BY TYPE OF INSTRUCTIONAL MATERIAL, ACQUISITION PHASE

Learning Task (Test)	Type of Instructional Material			
	Learning Aids	Programmed Instruction	Traditional	Mean
Test 1: Recalling Facts About Equipment	72.7	67.3	49.1	64.4
Test 2: Applying Rules and Regulations	44.8	29.5	21.5	33.3
Test 3: Classifying Objects or Signals	56.1	43.4	30.8	44.9

The interaction between Type of Learning Task x Type of Instructional Material was nonsignificant ($F = 2.21$). However, with all types of instructional material, applying rules on how to light vessels was apparently a more difficult task to learn than recalling facts about the system of lights or classifying ships according to light patterns, or the tests varied in difficulty (i.e., test 2 was more difficult than tests 1 and 3).

Lack of an interaction between type of instructional material and type of learning task permits drawing inferences about the instructional formats used in the Learning Aids. The Learning Aids were superior to the other two types of instructional materials regardless of the task being learned.[2]

[2]The retention data indicated the same test result pattern as in acquisition, but the Type of Instructional Material x Type of Learning Task interaction was significant ($F = 3.88$, $p < .01$). In the Traditional text condition, there were only slight differences among the three test scores.

SECTION IV

CONCLUSIONS AND RECOMMENDATIONS

The present study indicates that training conducted with materials designed according to the format models produces better student performance than training conducted with programmed or traditional instructional materials. These findings are in agreement with the results of previous studies which show a superiority of format model-based materials over other types of instructional materials (Ainsworth, 1979; Polino and Braby, 1980; Scott, McDaniel, and Braby, 1982). However, in the present study, students performed below the level that would be acceptable in Navy schools, regardless of type of instructional materials. Possible causes for this low level of performance are discussed in the following paragraphs.

The generally low scores are thought to result from at least three factors: (1) method of instruction, (2) difficulty of the tests, and (3) motivation level of the students.

The method of using individualized materials in this demonstration varied from the way these types of materials are generally used in Navy classrooms. With individualized instruction it is accepted practice to give a student a block of instruction followed by cycles of diagnostic tests and remediation until the student reaches mastery. However, in this demonstration, mastery was not required. All practice and self-testing took place as the students studied the material. Study time and method were under student control. Students took tests only once, at the end of each module. The tests were not immediately scored, and no remediation was provided.

Test difficulty should also be considered in evaluating the results. The end of module tests were closed-book tests which required students to recall a large number of facts and to apply these facts to job-like situations. Recall tests of this type are more difficult than multiple choice tests typically used with individualized instruction where students merely choose among options. The present QM course objective is to familiarize students with the contents of CG-169 so that they can refer to it quickly and proficiently on the job. Very little memorization is required. The primary mode of testing in the course is multiple choice and open-book.

Also, the motivation level of students appeared low. Students voiced their concern to the examiner about taking three difficult tests in one day. They were assured that the grades would not be used to determine passing the course, but that they would be responsible for the information as part of their comprehensive final exam. It was apparent that students did not consider passing the tests as necessary for success in the course.

The attempt to improve student performance by requesting instructors to increase their participation in the instructional process was not successful. However, no quantifiable data are available to describe actual instructor behavior during either phase of the evaluation. Based on observations by the experimenters, it is believed that the instructors did not carry out their assigned role to the fullest extent in phase two. Certain instructors had to be reminded of the various new behaviors expected of them (e.g., spot-

checking student knowledge of the material before administering an end of module test). By phase two of the study, the instructors were aware that student test performance with all types of material was low. This awareness seemed to result in a low level of enthusiasm for carrying out their prescribed roles.

Improved student performance is the goal of instructional development, but cost effectiveness of the materials is an equally important objective. The Learning Aids are significantly more expensive to produce than the programmed instruction or traditional materials. This added cost is due, in part, to the frequent use of graphics, the low density of information per page, and the additional pages required by frequent exercises and self-tests. The relatively high cost of producing the Learning Aids should be weighed against the needed level of student performance before a decision is made to use the Learning Aid format.

CONCLUSIONS

The following conclusions are based on the results and the observations described above.

- Learning Aids designed according to format models for specific tasks are superior to programmed instruction or the traditional Quartermaster School text for teaching the recalling of facts about systems of lights on a vessel, applying rules for lighting vessels, and classifying vessels according to light patterns.

- Students using Learning Aids spend more time studying than do students using programmed instruction or the traditional text.

- Although the experimental design precludes an assessment of the effectiveness of individual format models, techniques common to all three format models have been demonstrated to be effective. These are:

  .. division of material into small, easily learned blocks

  .. use of illustrations to present visual information such as appearance of objects or signals, locations, and spatial relationships

  .. distributed practice through providing exercises, self-tests, and directions for remediation at appropriate points in the module

  .. immediate feedback on student responses.

- Applying rules for lighting vessels is a difficult learning task regardless of the type of instruction. The difficulty is apparently due to heavy requirements for memorization and concept application.

- Students classified as "below average" in aptitude who use the Learning Aids perform the same or better on written tests than

"above average" students who receive programmed instruction or the traditional text.

- The performance of students who use Learning Aids is superior to that of students using programmed instruction or the traditional text one week after original learning.

- The lack of effect due to instructor intervention suggests a need to define the role of the instructor and to provide appropriate training for various forms of instruction.

RECOMMENDATIONS

1. Use the format models to create instructional materials for (1) recalling facts about equipment, (2) applying rules and regulations, and (3) classifying objects and signals. However, the following cautions should be exercised:

   - Because of the higher cost of producing these materials as compared with more traditional materials, ensure that the expected increase in student performance is worth the added cost.

   - Because mastery level of learning calls for significantly more effort than familiarization, if mastery is required, then student performance must be managed to ensure mastery is achieved.

2. Use Learning Aids for students of all aptitude levels.

3. Use the Learning Aid modules in the Quartermaster "A" School with the following modifications:

   - allow students to use the U.S. Coast Guard Navigation Rules, CG-169 or its equivalent when carrying out exercises or taking tests

   - grade tests at the end of each module immediately, and require mastery before the student is allowed to proceed to the next module. This will encourage students to use the remediation capabilities of the Learning Aids.

4. Ensure that additional applications of the methods described in this report follow the prescription of NAVEDTRA 110A and the revisions contained in the Handbook of Format Models for Designers of Technical Training Materials (Braby, Hamel, and Smode, 1982).

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APPENDIX A

GUIDELINES FOR INSTRUCTOR PARTICIPATION: ACTIVE ROLE

GUIDELINES FOR INSTRUCTOR PARTICIPATION: ACTIVE ROLE

1. Subject Matter Expert

   The instructor has mastered the contents of the three modules, and can answer questions as an authority on their contents.

2. In Command of Instructional Program in Classroom

   a. Instructor introduces lesson (5-10 minute lecture)

   - provides advanced organizers--relates new topics to previous study
   - establishes why students should learn:
     .. your job will be to aid OODs in avoiding collisions; knowing the Rules of the Road: Lights is an important skill. (Present examples of collisions when rules were broken.)
   - overviews the lesson:
     .. gives a presentation of the essential elements of the course:

     Section I--module exercises, self-test, Section I test. (You need to know this in order to do module II.)

     Section II--module exercises, self-tests, Section II test. (You need to know this in order to do module III.)

     Section III--module exercise, self-test, Section III test.
   - gives directions for studies:

     (1) Read module

     (2) Take self-test(s)--write answer on paper if you need to

     (3) Check answers, and keep studying until you know the material

     (4) Tell instructor when you're ready to take the written, closed-book test and have him spot check you on self-test

     (5) Take the section test (closed-book) which will be given to you by either the instructor or his assistant

     (6) Turn in test to instructor (or assistant) and obtain the next module

- Motivates students (part of initial lecture):

  .. demonstrates enthusiasm for a thorough knowledge of Rules of the Road.

b. Instructor coaches students while they study. He walks among students and interacts with individual students. He uses the following coaching techniques:

- Proactive questioning: Asks basic questions of individual students who seem to be having difficulties or are unattentive.

- Answers student questions: Attempts to diagnose student problem, and prescribes specific study; attempts to relate personal experience, and other pertinent information, to overcome student problems with course material.

- Motivates students: Demonstrates enthusiasm for a thorough knowledge of navigation lights in the Quartermaster's occupational specialty. Ensures that underachievers are exposed to this enthusiasm (individually).

- Keeps student engaged in an efficient pace of study:

  .. gives special attention to those who seem not engaged in study

  .. encourages students to take a break after each test and at other times following any significant accomplishment

  .. makes sure students complete required study (looks at paperwork, asks questions, etc.).

3. Beliefs that Influence Instructor Behavior

- Demonstrates a liking for all students. Learns something about the personal background of each.

- Believes that all students can learn. Willingly devotes time and effort to ensure that all do learn.

- Stresses the competition between the individual and the learning objectives.

- Teaches that the task is to master the learning objectives, rather than merely pass test.

- Gets students overprepared so that the tests will seem easy.

4. Discipline

- Makes privilege or any course-related reward contingent upon achievement.

- Students take breaks individually when the instructor decides the student has successfully completed a portion of the material. Some examples of when a break could be allowed:

  .. after completing a certain number of practice exercises successfully

  .. after completing a written test

  .. after completing a self-test successfully.

5. Explanation of test-taking procedures and test directions.

APPENDIX B

ANALYSIS OF VARIANCE (ANOVA) TABLES

TABLE B-1. ANOVA SOURCE TABLE FOR ACQUISITION PHASE

Source of Variation	SS	MS	df	F	p*
Between Subjects					
A (Instructor Participation)	260.3	260.3	1	0.46	ns**
B (Type of Instructional Material)	50242.9	25121.5	2	44.28	<.001
C (Aptitude)	19098.1	19098.1	1	33.66	<.001
AB	3679.4	1839.7	2	3.24	ns
AC	586.5	586.5	1	1.03	ns
BC	236.9	118.5	2	0.21	ns
ABC	2564.3	1282.2	2	2.26	ns
Between Error	95317.2	567.4	168		
Within Subjects					
J (Job Task)	89409.2	44704.6	2	182.01	.001
AJ	1233.2	616.6	2	2.51	ns
BJ	2174.8	543.7	4	2.21	ns
CJ	819.3	409.6	2	1.67	ns
ABJ	681.3	170.3	4	0.69	ns
ACJ	16.3	8.2	2	0.03	ns
BCJ	3070.4	767.6	4	3.12	ns
ABCJ	733.7	183.4	4	0.74	ns
Within Error	82524.5	245.6	336		

*p = probability with conservative df adjustment.
**ns = not significant.

TABLE B-2. ANOVA SOURCE TABLE FOR RETENTION PHASE

Source of Variation	SS	MS	df	F	p*
Between Subjects					
A (Type of Instructional Material)	19833.9	9941.9	2	16.73	<.001
B (Aptitude)	14836.8	14836.8	1	24.97	<.001
AB	2482.2	1241.1	2	2.09	ns**
Between Error	92707.3	594.3	156		
Within Subjects					
J (Job Task)	39431.5	19715.8	2	83.64	<.001
AJ	3660.1	915.0	4	3.88	<.01
BJ	128.0	64.0	2	0.27	ns
ABJ	306.8	76.7	4	0.32	ns
Within Error	73544.8	235.7	312		

*p = probability with conservative df adjustment.
**ns = not significant.

APPENDIX C

EXCERPTS FROM LEARNING AID FORMAT MATERIAL*

*The examples are not reprinted in color.

EXCERPTS FROM LEARNING AID FORMAT MATERIAL

Selected pages from the Learning Aids are presented in this appendix so that the reader can inspect them and observe the sequence of events experienced by the users of these materials.

SECTION I, Nomenclature: Basic Components of Lights Governed by Rules of the Road

The eight page sample from this section shows how the section is organized, what equipment subsystems make up the larger system, and an exercise for recalling this information. Then one of the subsystems is presented in greater detail, followed by an exercise for recalling that information. A sample self-quiz is presented for recalling information about two subsystems, followed by the answers for the self-quiz.

SECTION II, Rule Learning: Rules of the Road: Lights

As in the previous section, the first page describes the organization of the section. Then a rule is given, along with the meanings of key words in the definition. Typical situations where the rule applies and confusing situations where it does not apply are described. The application of the rule is also demonstrated. Next, the student is presented with an opportunity to practice recalling this information. This is followed by a sample application exercise, and then the answers to the exercise. The next sample page contains a Practice Your Job exercise calling for the application of a number of rules from previous exercises.

SECTION III, Classifying Situations by Lights

As before, the first page describes the organization of this section. Presented next is a pattern to be classified, cues to be used in making the classification, examples, and an exercise in recalling this information. This is followed by an exercise in making classifications, and answers to this practice task. One page of a self-test and its answer page are presented. This test covers all the classification tasks in the module. This test format is also used for intermediate exercises combining a smaller number of classification tasks.

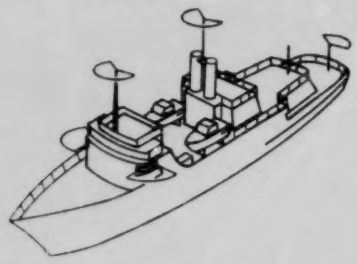
SECTION I

NOMENCLATURE: BASIC COMPONENTS OF LIGHTS GOVERNED BY RULES OF THE ROAD

TYPES OF LIGHTS

The Quartermaster must know and be able to interpret **The Rules of the Road** in order to light his own vessel and to identify the characteristics and activity of other vessels to prevent collision at sea. To understand the Rules, you need to know about the systems of lights on vessels. This booklet will help you learn them, but you will also need to read *U. S. Coast Guard Navigation Rules: International and Inland* (referred to as CG-169).

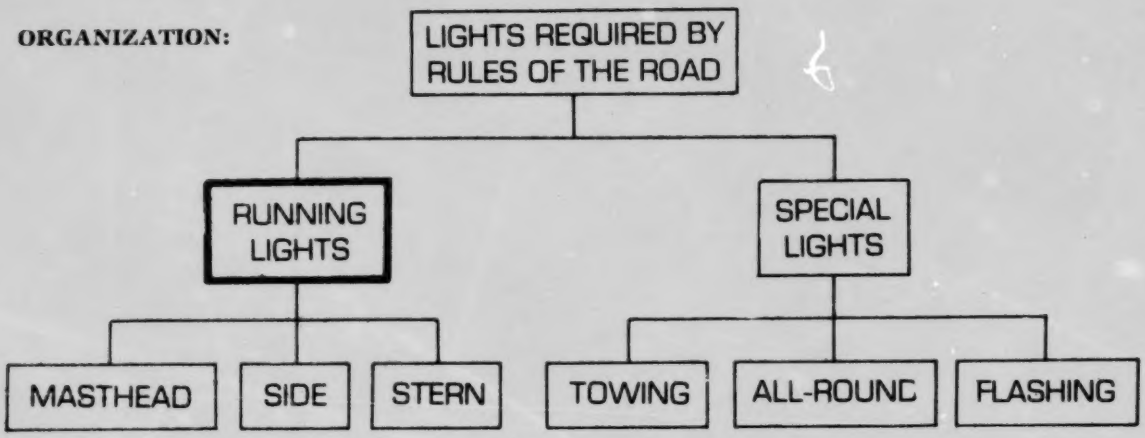
After completing this booklet you should be able to name the lights governed by **The Rules of the Road** and describe the characteristics of individual lights.



Running Lights—vessel 50 meters or more in length

The vessel shown here has typical running lights. There are special lights which will be described later in this booklet that are often combined with running lights.

ORGANIZATION:



—First, you will be given an introduction to each set of lights.

—Next, you will be given an exercise to test your ability to recall the characteristics of each light.

—Then, after each major section (Running and Special Lights) you will use a self-quiz to determine whether you are ready to go on or if you require more practice.

—Finally, you will take a self-test over all these lights.

TESTING: Your instructor will test you with material similar to the exercises.

** Double asterisks indicate words found in the glossary at the back of the booklet.

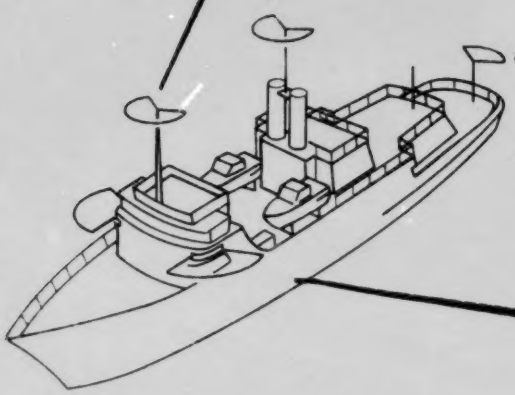
RUNNING LIGHTS are lights required on a vessel to indicate to other vessels its presence, and direction of travel, in order to prevent **collisions** during the hours of darkness or if there is reduced visibility. They are often used in **combination** with **special** lights to indicate a vessels **activity** .

1. **Masthead** Lights

Rule 21(a), p. 24 *

NOTE: The **second** (after) masthead light is optional for vessels less than **50** meters in length.

Rule 23(a)(ii), p. 28 *



2. **Sternlight**

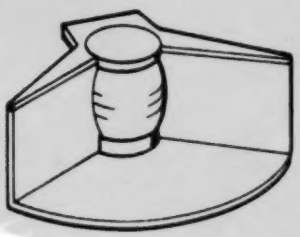
Rule 21(c), p. 24 *

3. **Sidelights** (**Port** and **Starboard**)

Rule 21(b), p. 24 *

4. You can't see all these lights from every **position** . All Running Lights have **screens** painted matte black to block light from certain angles.

Both Running and Special Lights have **bottom** screens to prevent light from reflecting on the vessel.



* This information is provided so you can read the appropriate rule in CG-169.

EXERCISE

DO NOT WRITE IN THIS BOOKLET

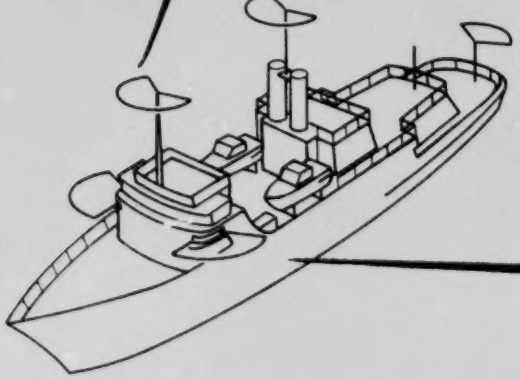
RUNNING LIGHTS are lights required on a vessel to indicate to other vessels its presence, direction of travel, and type of operations in order to prevent _____ during the hours of darkness or reduced visibility.

1. _____ Lights

Rule 21(a), p. 24

NOTE: The _____ (after) masthead light is optional for vessels less than __ meters in length.

Rule 23(a)(ii), p. 28



2. _____

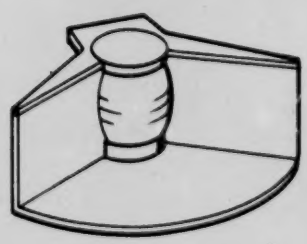
Rule 21(c), p. 24

3. _____ (___ and _____)

Rule 21(b), p. 24

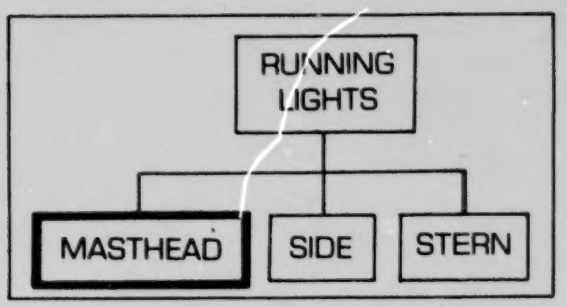
4. You can't see all these lights from every _____. All Running Lights have _____ painted matte black to block light from certain angles.

Both Running and Special Lights have _____ screens to prevent light from reflecting on the vessel.



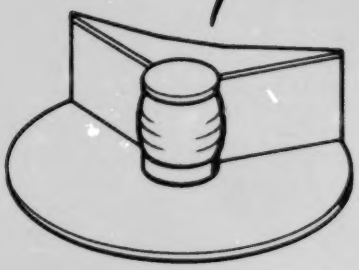
—If you missed any answers, go back and study page 3. Then repeat the exercise.

—**Next you will learn the characteristics of each of the Running Lights.**



1. **Color:**
White

Rule 21(a), p. 24.

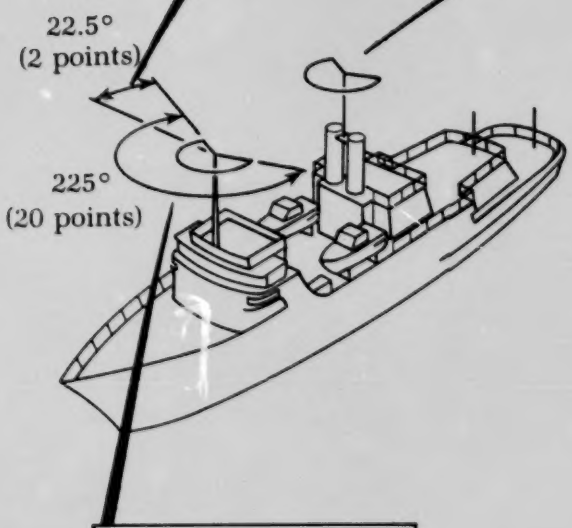


4. **Aim:**
Can be seen from **dead ahead** ** to **22.5°** abaft** the beam** on either side of the vessel.

Rule 21(a), p. 24.

2. **Location:**
Placed over the fore and aft **center line** of the vessel.

Rule 21(a), p. 24, CG-169.



NOTE: A second masthead light **abaft** of and **higher** than the forward one. A vessel of less than **50** meters shall not be obliged to exhibit such a light but may do so.

Rule 23(a)(ii), p. 28, CG-169.

3. **Arc:**
Showing an unbroken light over an arc of the horizon of **225°** (20 points).

Rule 21(a), p. 24.

NOTE: Sometimes the arc of a light is described in points.

One point equals **11-1/4** degrees which is 1/32 of a circle.

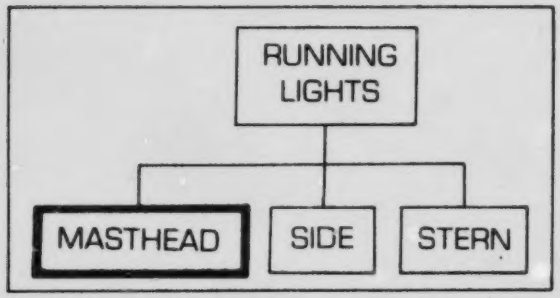
Masthead light	225°	20 pts
Sidelight	112.5°	10 pts
Sternlight	135°	12 pts
All round light	360°	32 pts

Read the following rules before going on:

Rule 21(a), p. 24, CG-169
Rule 23(a)(ii), p. 28, CG-169.

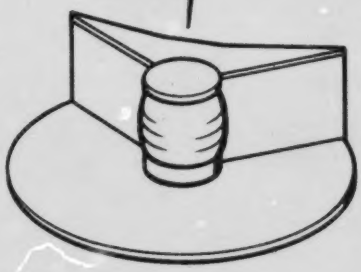
** Double asterisks indicate words found in the glossary at the back of the booklet.

EXERCISE **DO NOT WRITE IN THIS BOOKLET**



1. Color:
_____

Rule 21(a), p. 24.

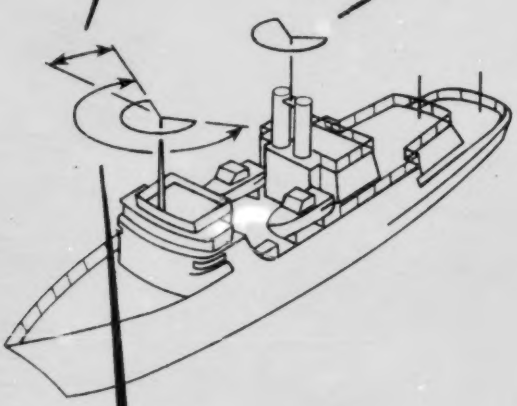


2. Location:
Placed over the fore and aft _____ ___ of the vessel.

Rule 21(a), p. 24, CG-169.

4. Aim:
Can be seen from _____ _____ to _____ abaft the beam on either side of the vessel.

Rule 21(a), p. 24.



NOTE: A second masthead light _____ of and _____ than the forward one. A vessel of less than __ meters shall not be obliged to exhibit such a light but may do so.

Rule 23(a)(ii), p. 28, CG-169.

3. Arc:
Showing an unbroken light over an arc of the horizon of ____ (20 points).

Rule 21(a), p. 24.

NOTE: Sometimes the arc of a light is described in points.

One point equals _____ degrees which is 1/32 of a circle.

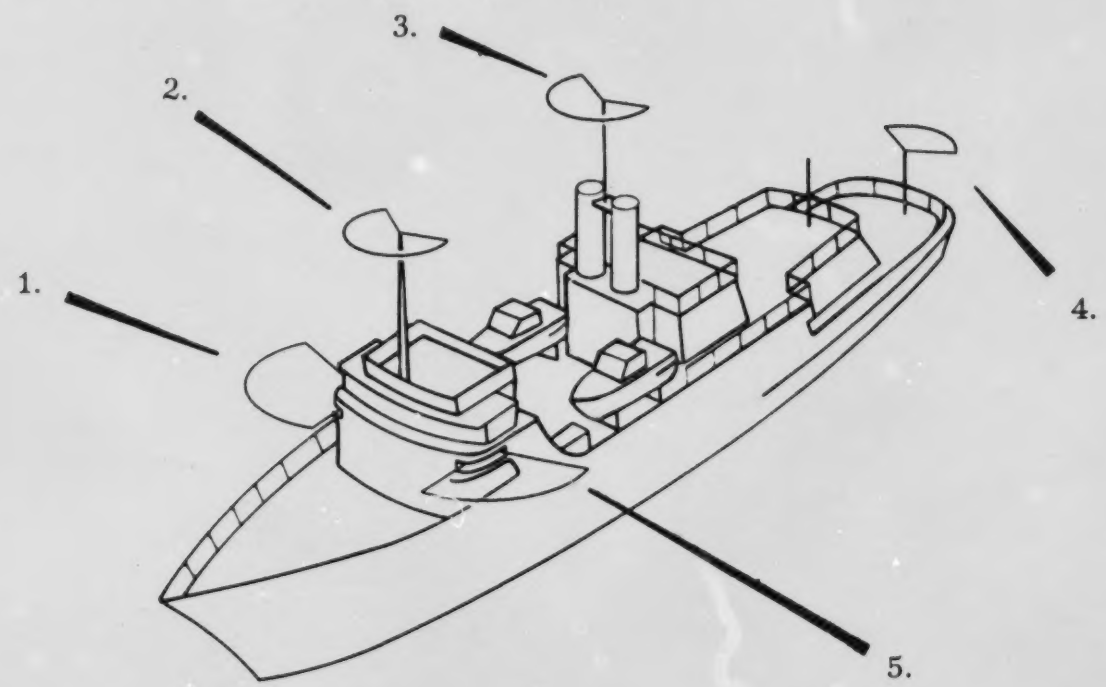
Masthead light	225°	20 pts
Sidelight	112.5°	10 pts
Sternlight	135°	12 pts
All round light	360°	32 pts

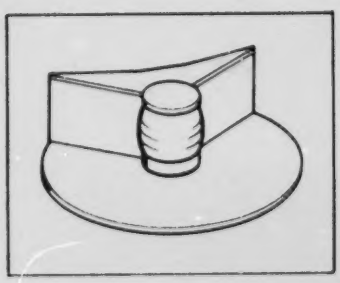
If you missed any answers, go back and study Page 5. Then repeat the exercise.

SELF QUIZ —RUNNING LIGHTS

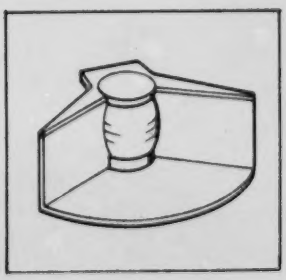
for each Running Light:
—select the **graphic** of the light
—write the **name**
—write the **color**
—write the **location**
—write the **arc**
—write the **aim**

(USE NOTE PAPER—DO NOT WRITE IN THIS BOOKLET)

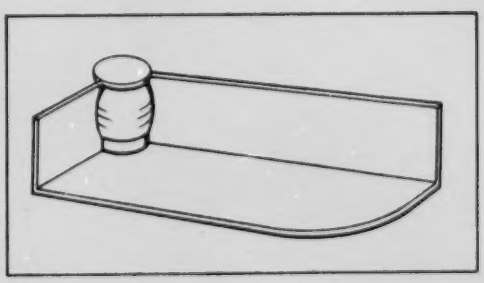




GRAPHIC A



GRAPHIC B



GRAPHIC C

Self Quiz—Running Lights

ANSWERS

1. Starboard Sidelight
   Graphic C
   Color Green
   Location Starboard
   Arc 112.5°
   Aim dead ahead to 22.5° abaft beam

   Rule 21(b), p. 24.

2. Masthead Light
   Graphic A
   Color White
   Location over fore and aft center line
   Arc 225°
   Aim dead ahead to 22.5° abaft beam either side.

   Rule 21(a), p. 24.

3. Masthead Light
   Graphic A
   Color White
   Location abaft and higher than forward masthead light
   Arc 225°
   Aim dead ahead to 22.5° abaft beam either side.

   Rule 23(a)(ii), p. 24.

4. Sternlight
   Graphic B
   Color White
   Location stern
   Arc 135°
   Aim dead astern to 67.5° either side

   Rule 21(b), p. 24.

5. Port Sidelight
   Graphic C
   Color Red
   Location Port
   Arc 112.5°
   Aim dead ahead to 22.5° abaft beam

   Rule 21(b), p. 24.

—Repeat this exercise until you can recall the characteristics of each light correctly and easily.
—Next you will learn the characteristics of each Special Lights.

Section II

Rule Learning:

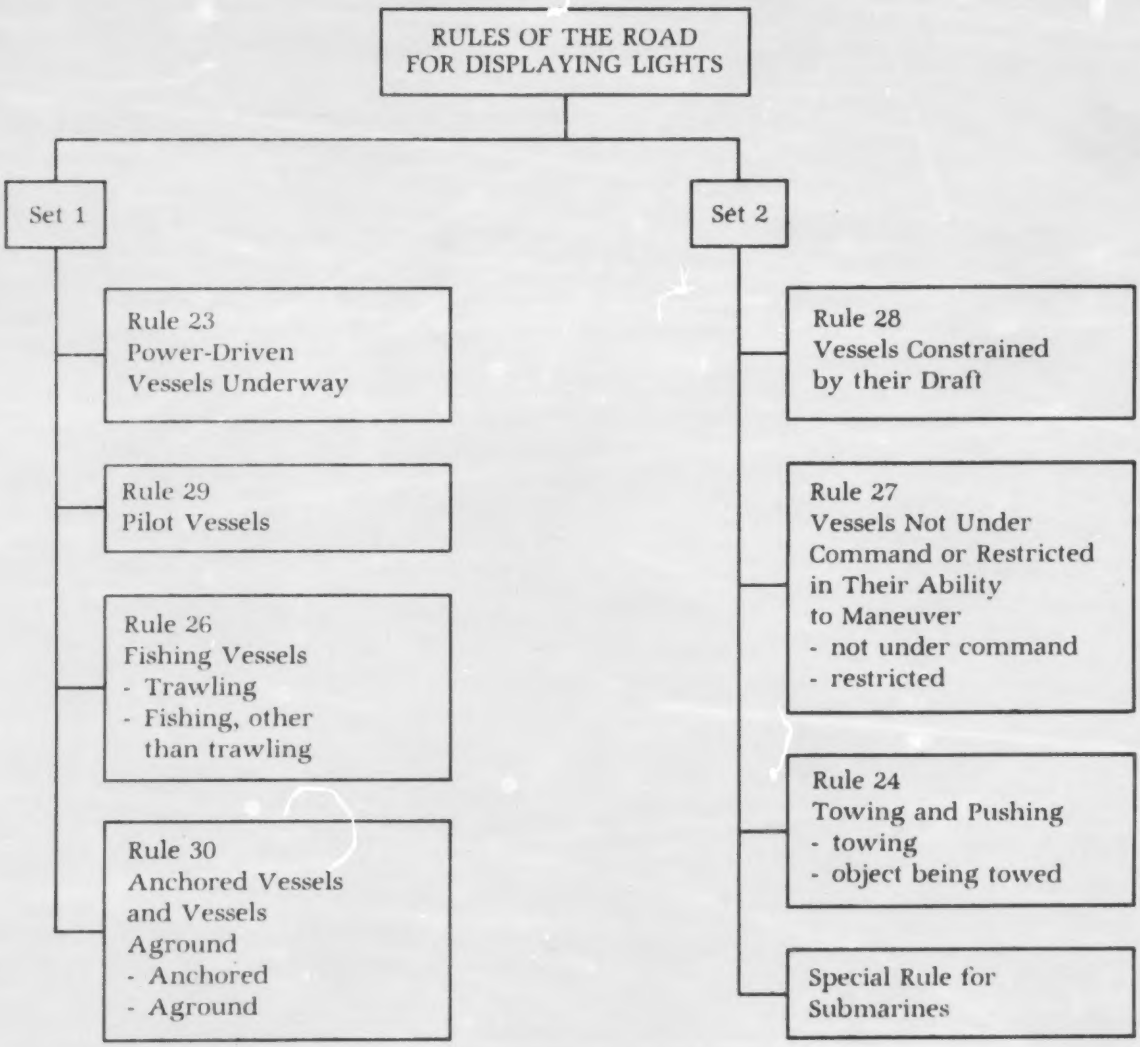
Rules of the Road: Lights

RULES OF THE ROAD FOR DISPLAYING LIGHTS

The Quartermaster must know the U.S. Coast Guard Navigation Rules that govern the use of lights on vessels. You will find the most commonly used rules included in this booklet. By completing the exercises in this booklet, you will learn to correctly apply these rules to the typical situations found at sea.

This booklet does not eliminate the need for you to read the rules as published in the *U. S. Coast Guard Navigation Rules (CG-169).* Rather this booklet will make it easier for you to use CG-169 in responding to a wide range of situations requiring a knowledge and application of the rules.

ORGANIZATION


RULES OF THE ROAD FOR DISPLAYING LIGHTS
Set 1
Rule 23 Power-Driven Vessels Underway
Rule 29 Pilot Vessels
Rule 26 Fishing Vessels - Trawling - Fishing, other than trawling
Rule 30 Anchored Vessels and Vessels Aground - Anchored - Aground
Set 2
Rule 28 Vessels Constrained by their Draft
Rule 27 Vessels Not Under Command or Restricted in Their Ability to Maneuver - not under command - restricted
Rule 24 Towing and Pushing - towing - object being towed
Special Rule for Submarines

For each rule:

- First, key terms used in the rules will be defined.
- Next, the rule will be presented.
- Then, you will be given exercises to practice your ability to apply the rule.

Following each set of rules:

- An exercise will be presented including each of the rules in the set.

DO NOT WRITE IN THIS BOOKLET

Rule 23a, Vessel Underway.....Navigation Rules CG-169

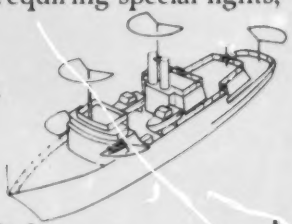
Important terms:

Power-driven vessel	Any vessel propelled by **machinery** .
Underway	Vessel **not** at **anchor** , or **made fast** to the shore or **aground** .
Making way	Vessel **moving** through the water propelled by its own power.
Not making way	Vessel **dead** in water—drifting—not propelled by its own power.
Abaft	Toward the **stern** .

Rule: A power-driven vessel underway shall exhibit:
- a **masthead** light **forward** .
- a **second** masthead light (also called **after**) **abaft** of and **higher** than the forward one (vessels less than 50 meters not required to exhibit this light)
- **sidelights**
- **sternlight**

Note: All vessels must display some type of light when underway at night. These lights are displayed by vessels NOT engaged in a task requiring special lights, whether making way or not making way.

These lights are often known as "running lights".



WHERE RULE APPLIES

Typical Situations	Application of Rule
Vessel: - U.S. Navy Destroyer - making way at 10 knots - 119 meters long	- Underway, **masthead** light, **sidelights** , **sternlight** - More than 50 meters: **second (after) masthead light**
Vessel: - Patrol Craft underway - making way at 14 knots - 25 meters long	- Underway, **masthead** light, **sidelights** , **sternlight**
Vessel: - fishing - making way - dragging lines (trolling)	- underway - not restricted in ability to maneuver - **masthead** lights, **sidelight** , **sternlight**

WHERE RULE DOES NOT APPLY

Vessel: - not under command - making way	- restricted in ability to maneuver, Rule 23 is not the primary rule in this situation

Rule 23a. Vessel Underway ..... Navigation Rules CG-169

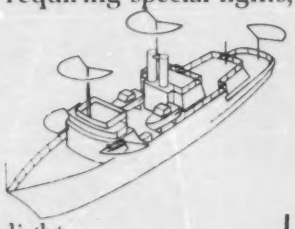
Important terms:

Power-driven vessel	Any vessel propelled by _____.
Underway	Vessel ___ at _____, or _____ to the shore or _____.
Making way	Vessel _____ through the water propelled by its own power.
Not making way	Vessel _____ in water—drifting—not propelled by its own power.
Abaft	Toward the _____.

Rule: A power-driven vessel underway shall exhibit:
- a _____ light _____ .
- a _____ masthead light (also called _____) _____ of and _____ than the forward one (vessels less than 50 meters not required to exhibit this light)
- _____
- _____

Note: All vessels must display some type of light when underway at night. These lights are displayed by vessels NOT engaged in a task requiring special lights, whether making way or not making way.

These lights are often known as "running lights".



WHERE RULE APPLIES

Typical Situations	Application of Rule
Vessel: - U.S. Navy Destroyer - making way at 10 knots - 119 meters long	- Underway, _____ light, _____, _____ - More than 50 meters: _____ ( ) _____
Vessel: - Patrol Craft underway - making way at 14 knots - 25 meters long	- Underway, _____ light, _____, _____
Vessel: - fishing - making way - dragging lines (trolling)	- underway - not restricted in ability to maneuver - _____ lights, _____, _____

WHERE RULE DOES NOT APPLY

Vessel: - not under command - making way	- restricted in ability to maneuver, Rule 23 is not the primary rule in this situation

DO NOT WRITE IN THIS BOOKLET

PRACTICE

Read each problem

If Rule 23 applies:
- state WHY
- light the vessel

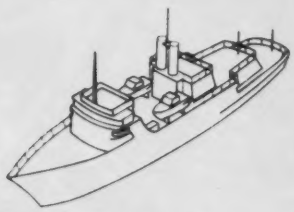
If Rule 23 does NOT apply:
- go on to the next problem

Problems

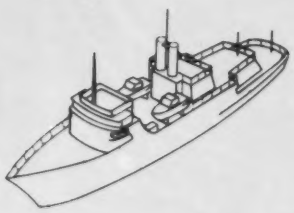
Does Rule 23 Apply?
If YES, WHY?

Light the Vessel

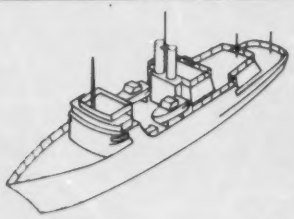
Vessel:
- cargo ship
- making way
- 95 meters long



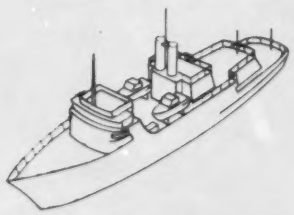
Vessel:
- tanker
- underway
- not making way
- 65 meters long



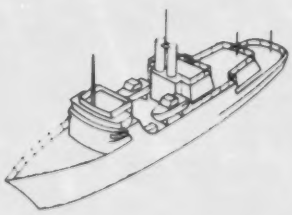
Vessel:
- tug, not towing
- making way
- 30 meters long



Vessel:
- at anchor
- 55 meters long

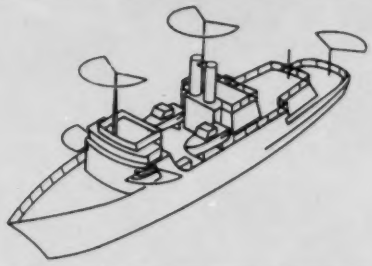
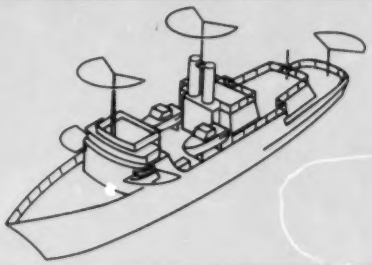
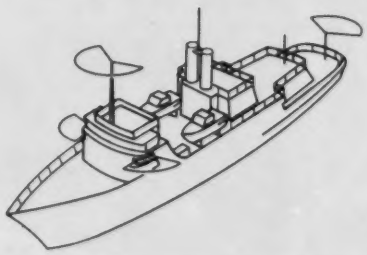


Vessel:
- pilot aboard
- not making way
- 10 meters long



PRACTICE

Answers

Problems	Does Rule 23 Apply? If YES, WHY?	Light the Vessel
Vessel: - cargo ship - making way - 95 meters long	- underway - more than 50 meters	
Vessel: - tanker - underway - not making way - 65 meters long	- underway - more than 50 meters	
Vessel: - tug, not towing - making way - 30 meters long	- underway	
Vessel: - at anchor - 55 meters long		
Vessel: - pilot aboard - not making way - 10 meters long		

If you missed any answers, go back and study the rules and then repeat the exercise. Change the order in which you look at the problems.

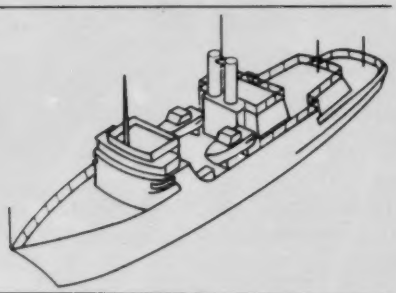
17

PRACTICE YOUR JOB

Problems	Which rule applies, and WHY?	HOW to light the vessel.

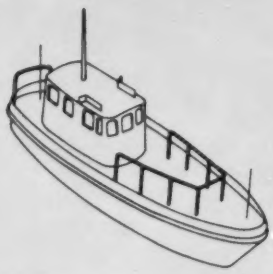
1

Vessel:
- dragging a large dredge net for shrimp
- making way
- 55 meters long



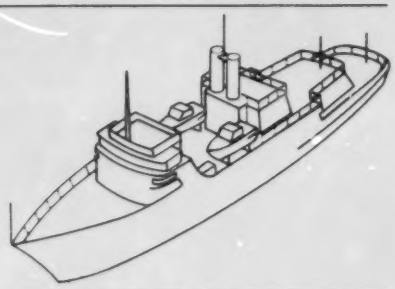
2

Vessel:
- pilot aboard
- underway to shift berth and take on fuel
- 12 meters long



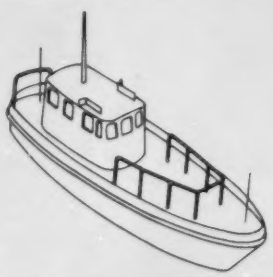
3

Vessel:
- aground
- 105 meters long



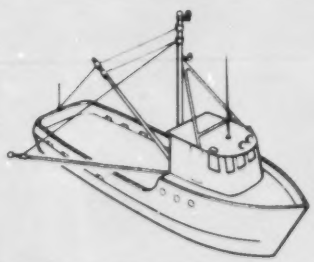
4

Vessel:
- pilot aboard—waiting to guide a ship
- anchored at rendezvous
- 10 meters long



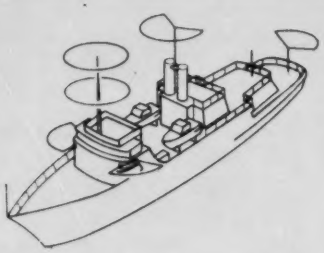
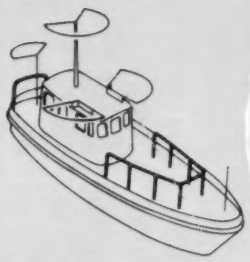
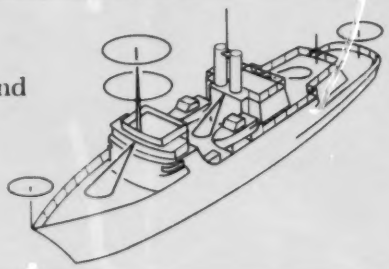
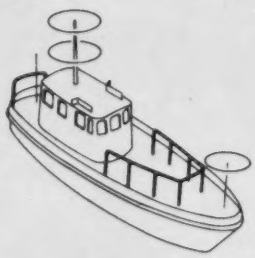
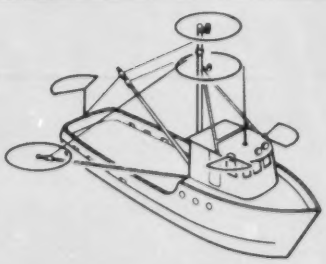
5

Vessel:
- laying a gill net
- making way
- 15 meters long
- starboard gear - extended 155 meters



PRACTICE YOUR JOB

Answers

Problems	Which rule applies, and WHY?	HOW to light the vessel.
1 Vessel: - dragging a large dredge net for shrimp - making way - 55 meters long	Trawling - dragging a dredge net - making way - more than 50 meters (See Rule 26b)	
2 Vessel: - pilot aboard - underway to shift berth and take on fuel - 12 meters long	Power-driven Vessels Underway (See Rule 23)	
3 Vessel: - aground - 105 meters long	Anchored Vessels and Vessels Aground - aground - more than 50 meters - more than 100 meters - (See Rule 30)	
4 Vessel: - pilot aboard—waiting to guide a ship - anchored at rendezvous - 10 meters long	Pilot Vessels - vessel engaged in pilotage duties - anchored (See Rule 29)	
5 Vessel: - laying a gill net - making way - 15 meters long - starboard gear - extended 155 meters	Fishing - Using fishing apparatus that restricts manueverability - making way - boom extended starboard (See Rule 26c)	

SECTION III:
CLASSIFYING SITUATIONS BY LIGHTS

Classifying Situations by Lights

As a quartermaster, you must be able to classify quickly and accurately the activity, direction, and other general characteristics of vessels at sea by the lights they display.

At the end of this booklet you will be able to read the language of lights and describe the situation displayed above.

ORGANIZATION

In this booklet, you will learn to apply much of the material you have already learned.

First, you will be given CUES—in pictures and words—to help you classify a vessel by her lights.

Next, you will rehearse these CUES.

Then, you will test yourself on a series of exercises to insure that you can use the CUES to correctly identify vessels' activities and headings.

Lastly, there will be exercises that include different yet similar patterns of lights to give you practice in recognizing these similar patterns.

TESTING

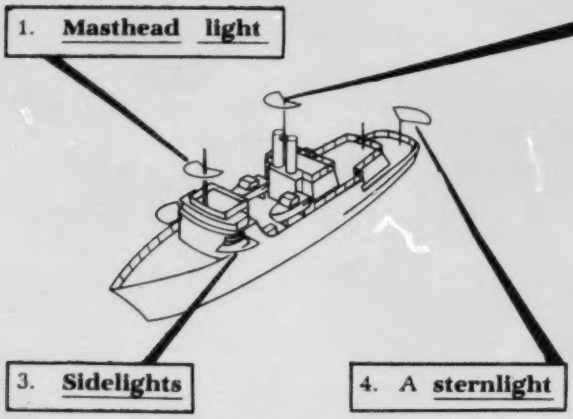
Your instructor will test you with material similar to the exercises when you finish this booklet.

NOTE

Not all light patterns are included in this test. You will find more complete information in CG-169.

CUES

VESSEL UNDERWAY


1. Masthead light
2. Second masthead light abaft and higher than first (vessel less than 50 meters not obliged to display)
3. Sidelights
4. A sternlight

NOTE: You **can't** see all the lights from one position.
Each light is masked in a certain direction.

NOTE: These lights are often called "**running** lights".

If You See...	Then You Know...
1. Two masthead lights and one or two sidelights...	Vessel is **underway**, probably **50** meters or more in length.
2. One masthead light lower than the other and one sidelight...	headed in direction of **lower** light (red sidelight - headed **left**) (green sidelight - headed **right**)
3. One masthead light and 2 sidelights...	headed **toward** you (less than **50** meters in length)
4. One masthead light over the other and two sidelights...	headed **toward** you (more than **50** meters in length)
5. One white light—no other lights...	Vessel may be headed **away** from you.*

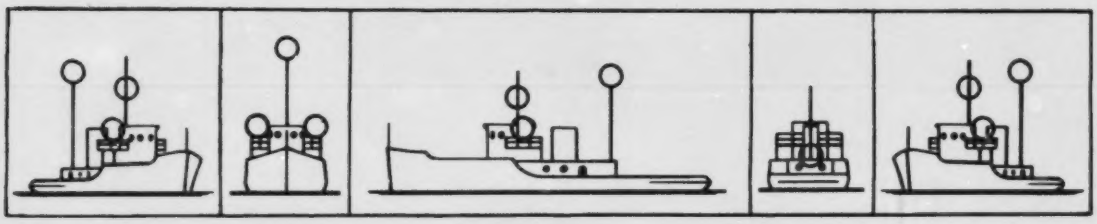
NOTE: If a vessel is **underway** and not engaged in a special activity, the light displays are the **same** whether it is **making way** or **not making way**.

***NOTE:** **Single** white lights are confusing. They may mean a variety of situations. Approach with caution.

EXAMPLES

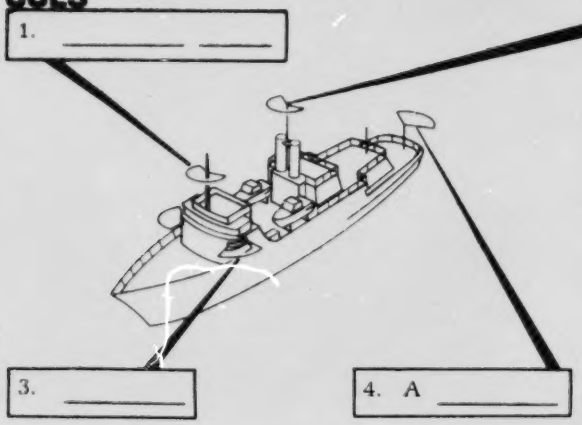
Identify the following as you view the vessel's lights from different angles in the pictures below:

1. Vessel's activity?
2. Is it underway?
3. Vessel's heading?
4. Is it 50 or more meters in length?



EXERCISE CUES

VESSEL UNDERWAY



NOTE: You _____ see all the lights from one position.
Each light is masked in a certain direction.

NOTE: These lights are often called "_____ lights".

If You See . . .	Then You Know . . .
1. Two masthead lights and one or two sidelights . . .	Vessel is _____ , probably __ meters or more in length.
2. One masthead light lower than the other and one sidelight . . .	headed in direction of _____ light (red sidelight - headed ____) (green sidelight - headed _____)
3. One masthead light and 2 sidelights . . .	headed _____ you (less than __ meters in length)
4. One masthead light over the other and two sidelights . . .	headed _____ you (more than __ meters in length)
5. One white light—no other lights . . .	Vessel may be headed _____ from you.*

NOTE: If a vessel is _____ and not engaged in a special activity, the light displays are the _____ whether it is _____ ___ or ___ _____ ___ .

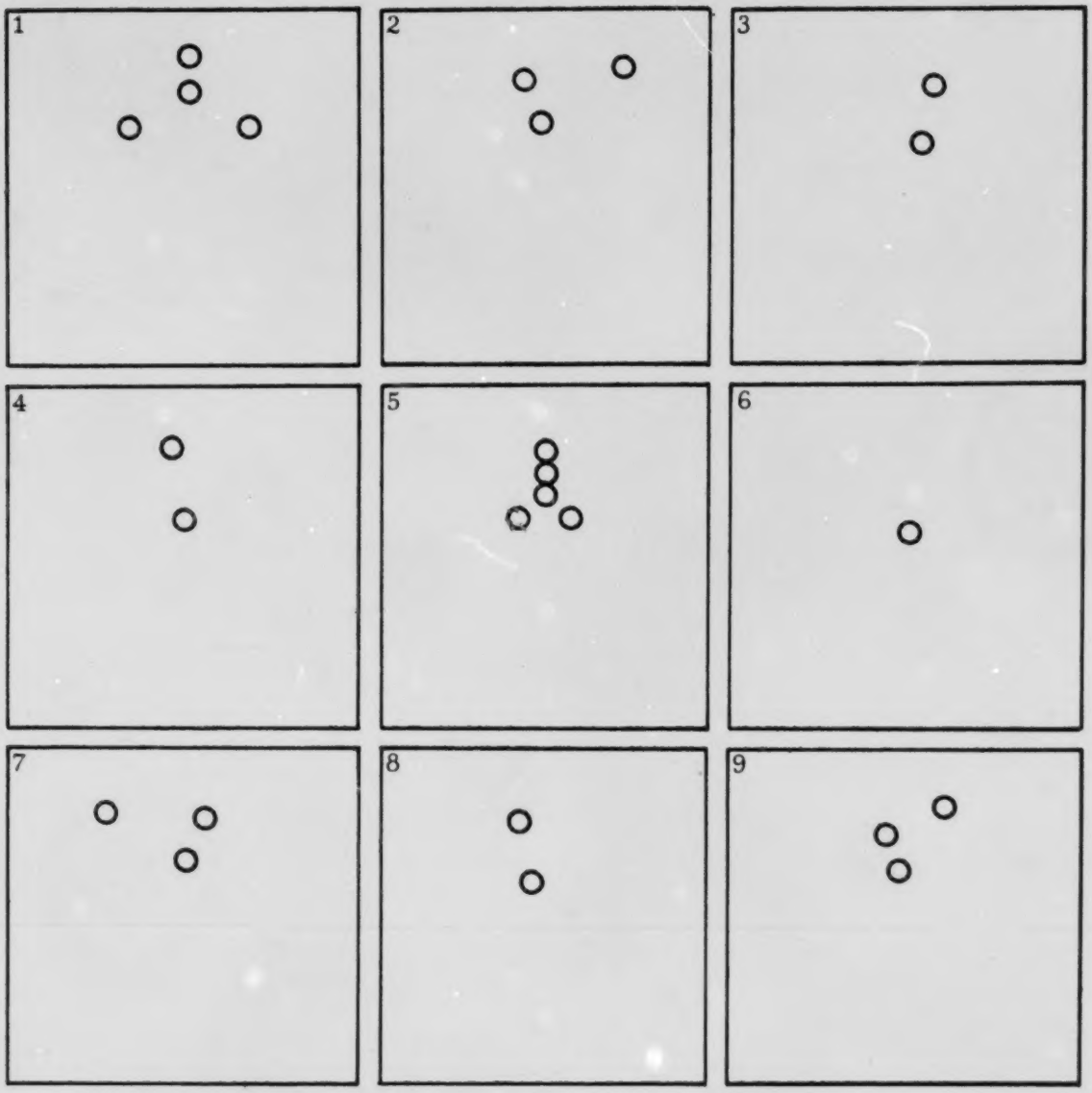
***NOTE:** _____ white lights are confusing. They may mean a variety of situations. Approach with caution.

PRACTICE — VESSEL UNDERWAY

Directions: Mentally describe the following for each vessel below:

1. Is it an example of a light we have covered?
   (If it is not, skip questions 2, 3, & 4)
2. Is it underway?
3. What is its heading?
4. Is it 50 or more meters in length?

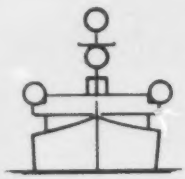
Check your description on the next page after each situation, but skip around the page to avoid seeing the answer to the next situation.



PRACTICE ANSWERS

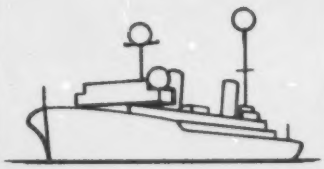
VESSEL UNDERWAY

1



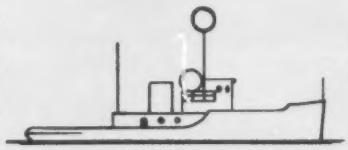
Underway
Heading toward you
50 meters or more

2



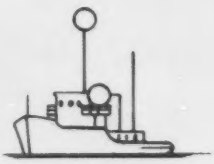
Underway
Heading left
50 meters or more

3



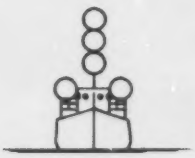
Underway
Heading right
Less than 50 meters

4



Underway
Heading left
Less than 50 meters

5

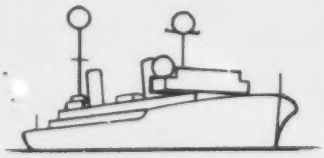


Non-example
Towing
Heading toward you
Underway
Tow more than 200 meters

6

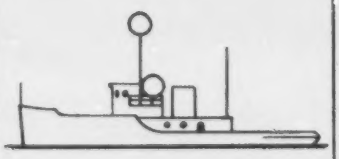
Cannot determine**

7



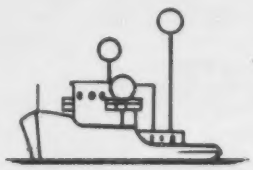
Underway
Heading right
50 meters or more

8



Underway
Heading left
Less than 50 meters

9



Underway
Heading left
50 meters or more

** NOTE: Single white lights are confusing. They can be: (1) Vessel underway headed away from you; (2) Anchor light on vessel less than 50 meters; (3) Anchor light on vessel 50 meters or more (second anchor light masked by vessel's superstructure).

All correct? Go to p. 90.

Missed some?

1) Restudy page 86.

2) Do this exercise again.

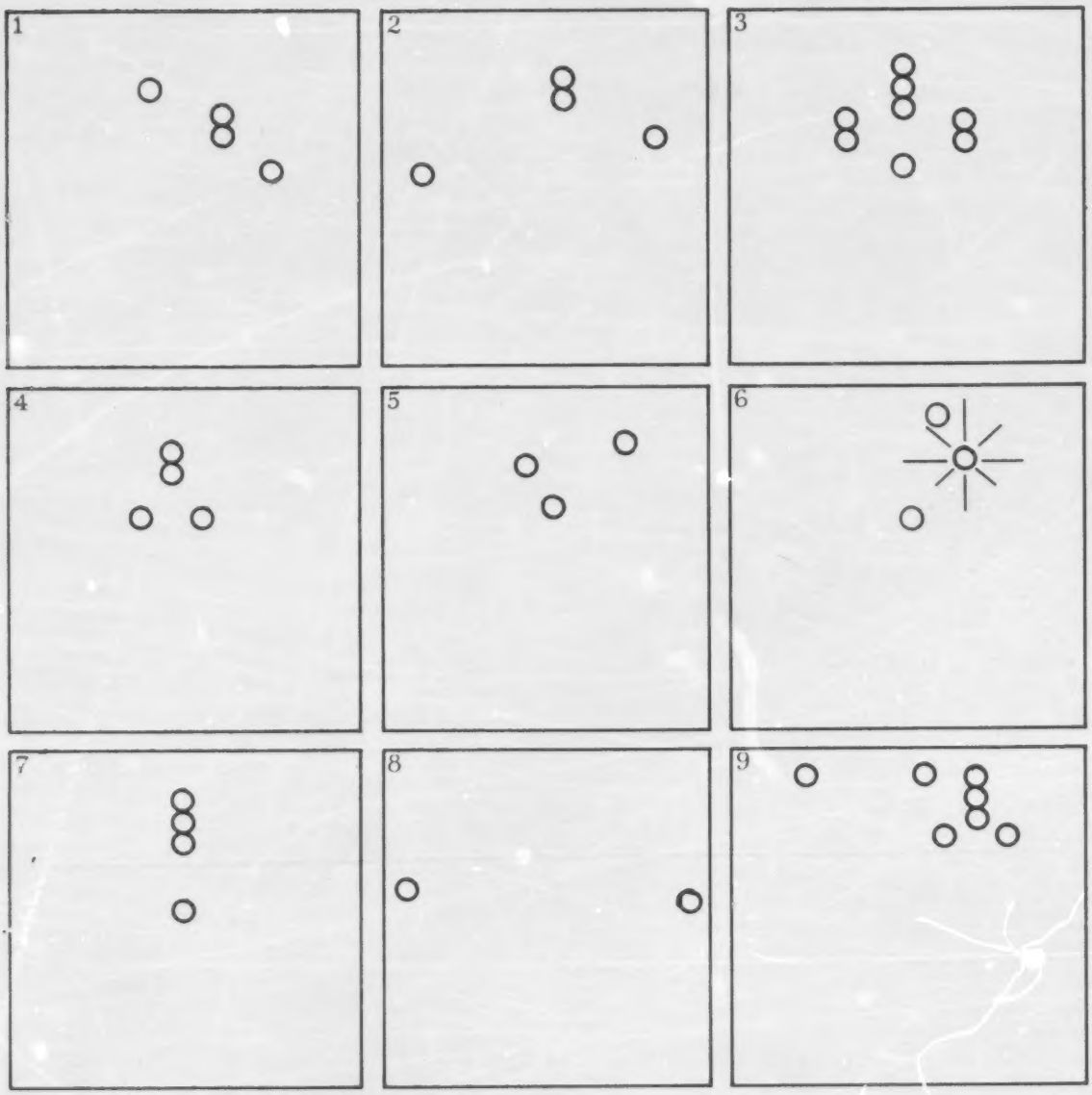
SELF TEST

DIRECTIONS: Use answer sheets provided

(1) In Column #1, mark the vessel's activity.

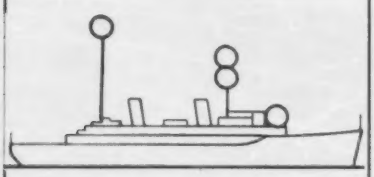
(2) In Column #2, mark the vessel's heading.

(3) In Column #3, mark whether the vessel is making way or not making way.



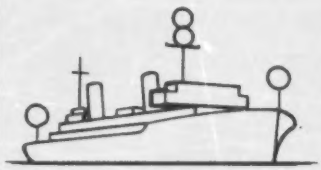
ANSWERS **SELF TEST**

1



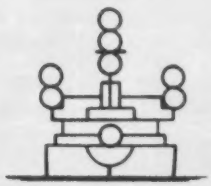
Trawling
Making way
Heading right
50 meters or more

2



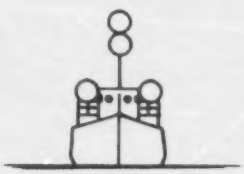
Aground
Not making way
Heading right
50 meters or more

3



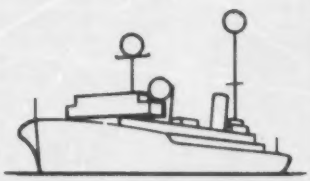
Dredging
Making way
Heading away from you
Obstruction - port

4



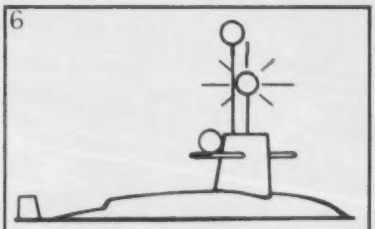
Fishing
Making way
Heading toward you

5



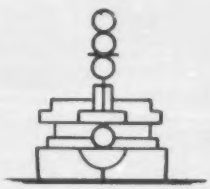
Running lights
Under way
Heading left
50 meters or more

6



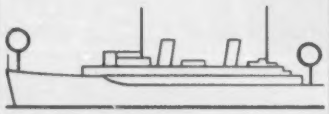
Submarine
Underway
Heading right

7



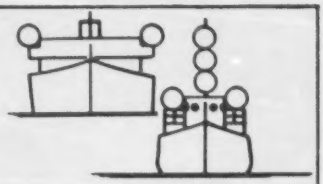
Constrained
Underway
Heading away from you

8



Anchored
Heading left
50 meters or more

9



Towing and towed vessel
Underway
Heading toward you
Tow less than 200 meters
Towing vessel less than
50 meters

APPENDIX D

EXCERPT FROM PROGRAMMED INSTRUCTION MATERIAL

EXCERPT FROM PROGRAMMED INSTRUCTION MATERIAL

The three learning tasks presented in the Learning Aid sections are also presented in three Programmed Instruction (PI) sections. Pages from the first section are presented in this appendix. The first four pages represent the PI format used throughout all three sections. The review pages and the self-test are representative of those found at the end of each of the three sections.

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SECTION I:

BASIC COMPONENTS OF LIGHTING SYSTEMS

Programmed Instruction

1. There are International and Inland Rules of the Road. While there are a number of differences in these two sets of regulations, the material covered in this section is the same in both. You will be studying International Rules.

---

2. All Rules of the Road require vessels to display lights during established times, places and situations. What lights must be shown during what times and under what circumstances are determined by the rules under which a vessel navigates.

---

3. When, where, and during what situations lights are to be displayed is defined in Navigation Rules under the section titled "Lights and Shapes." This section includes Rules 20 through 31 on pages 24 through 40. During established times under International Rules all vessels must display _____.

---

lights

---

4. Lights displayed by vessels fall into two categories and are listed as follows:

1. Running lights
2. Special lights

---

5. The first group of lights is known as running lights and these lights are shown while a vessel is underway. They are the masthead lights, the side lights, and the stern light. They will be covered in this order:

a. Masthead lights
b. Side lights
c. Stern light

---

6. Running lights consist of the _____ lights, the _____ lights, and the _____ light.

---

masthead
side
stern

---

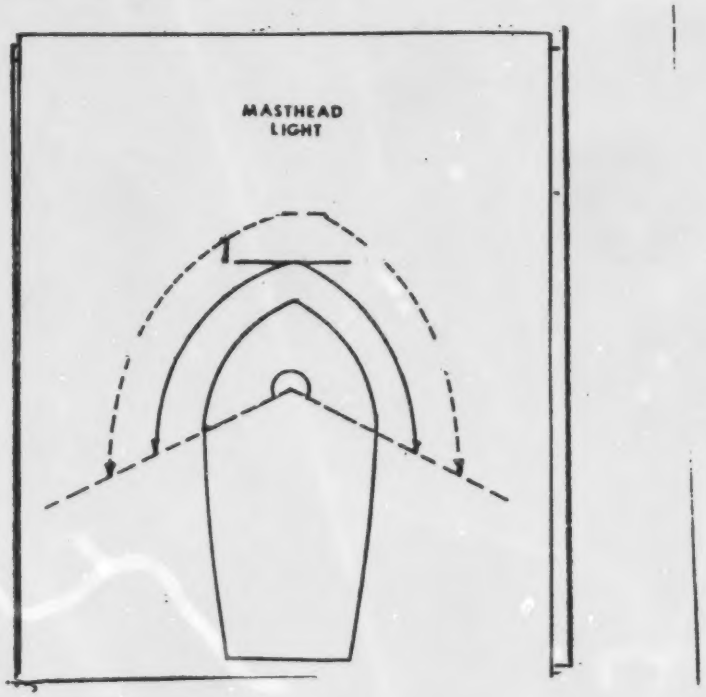
7. Read International Rules 20 to 22, pages 24-28.

8. The Rules concerning lights will be complied with from _____ to _____.

sunset

Sunrise

9.

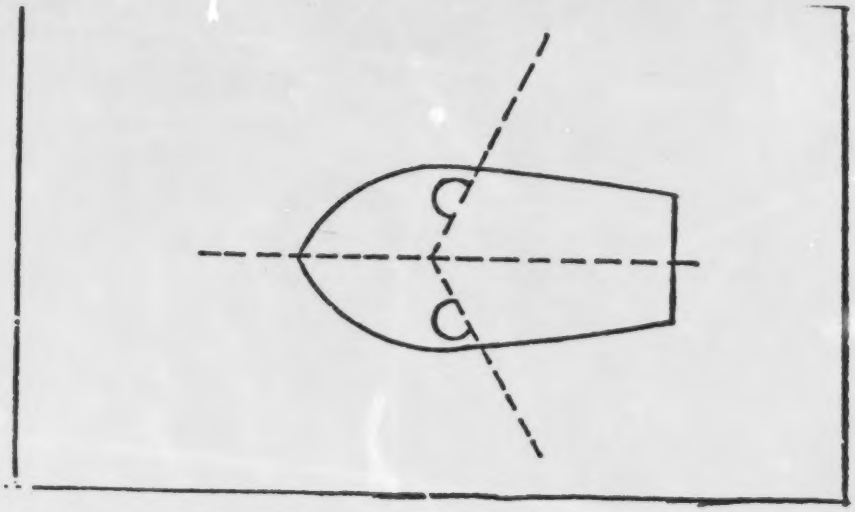


In the diagram above label the blank with the proper answer from International Rule 21 (a) on page 24.

225°

10. Sidelights are carried by all power-driven and stern vessels and are described by Rule 21 (b), page 24. Read Rule 21 (b).

11.



In the diagram above showing port and starboard side lights label the following:

a. Color of port light

b. Color of starboard light

c. Degrees of arc, port light

---

a. Red
b. Green
c. 112.5^{0}

---

12. By the International Rules, the technical details of lights are recorded in Annex I. Turn to page 56 and read Annex I, paragraph 5. Then turn to page 60 and read Annex I, paragraph 9. Complete the following statements:

Sidelights:

a. Shall be fitted with _____.

b. So as to prevent these lights from being seen more than _____ degrees outside the prescribed sector.

---

inboard screens
5

---

13. The requirements for a second white masthead light are found in International Rule 23 on page 28. Read this rule and answer the following questions:

a. Vessels of less than _____ meters shall not be required to carry this light.

b. Can they if they want to? Yes/No

c. The second masthead light shall be _____ than and _____ the first one.

50
Yes
higher, abaft

---

14. Now read Rules 21 and 22, and answer the following questions:

a. Masthead lights shall be placed over the fore and aft _____.

b. These lights are _____ degree lights.

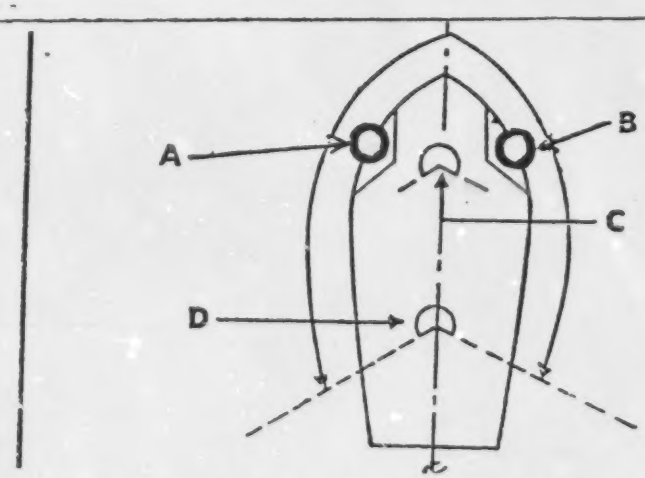
c. They are visible at a distance of at least _____ miles if the vessel's length is greater than 50 meters.

---

a. center line

b. 225
6

15.



Correctly label the colors of the lights shown above.

A. Red
B. Green
C. White
D. White

REVIEW

What is the basic understanding you have gained about lights? Let's go over what we have covered so far. There are two basic groups of lights that are displayed by vessels. They are running lights and special lights. Lights when required to be displayed by a vessel are displayed from sunset to sunrise, and in restricted visibility.

Running lights of some type are required of all vessels. In most cases, they consist of a masthead light, sidelights, sternlights, and in most cases a range or second masthead light. The masthead light is a white 225° light visible for 112.5° on each side of the vessel for 6 miles if the vessel is 50 meters or more in length. The starboard sidelight is a green light and the port sidelight is a red light. Both sidelights are 112.5° lights and shall be visible from right ahead to 22.5° abaft the beam on each side. The sidelights shall be screened in such a manner so as to prevent these lights from being seen across the bow. Seagoing vessels of 50 meters or greater are required to display a range or second masthead light. Smaller vessels may display a range light if they so desire. This range is a white 225° light similar in construction to the masthead light. A sternlight is required of all vessels and shall be a white 135° light visible at a distance of at least 2 miles.

Special lights are provided for in Rules of the Road. They apply to vessels restricted in their ability to maneuver. When these patterns of lights are shown, other vessels must give wide berth or stay entirely clear. Special lights are shown in such conditions as a vessel aground, a vessel not under command, vessels restricted in ability to maneuver, submarines on the surface, and towing vessels.

Three individual special lights were described. They are towing lights, all-round lights, and flashing lights. Towing lights are yellow lights, placed above the sternlight and having the same characteristics as sternlights. All-round lights can be white, red, green, or yellow and have arcs of 360 degrees. Flashing lights are a special case of all-round lights. Submarines and airboats display a special yellow flashing light. There are white all-round lights that may be used in conjunction with whistles that signal a vessel's intention to maneuver.

The visibility ranges of various lights are found in Rule 22.

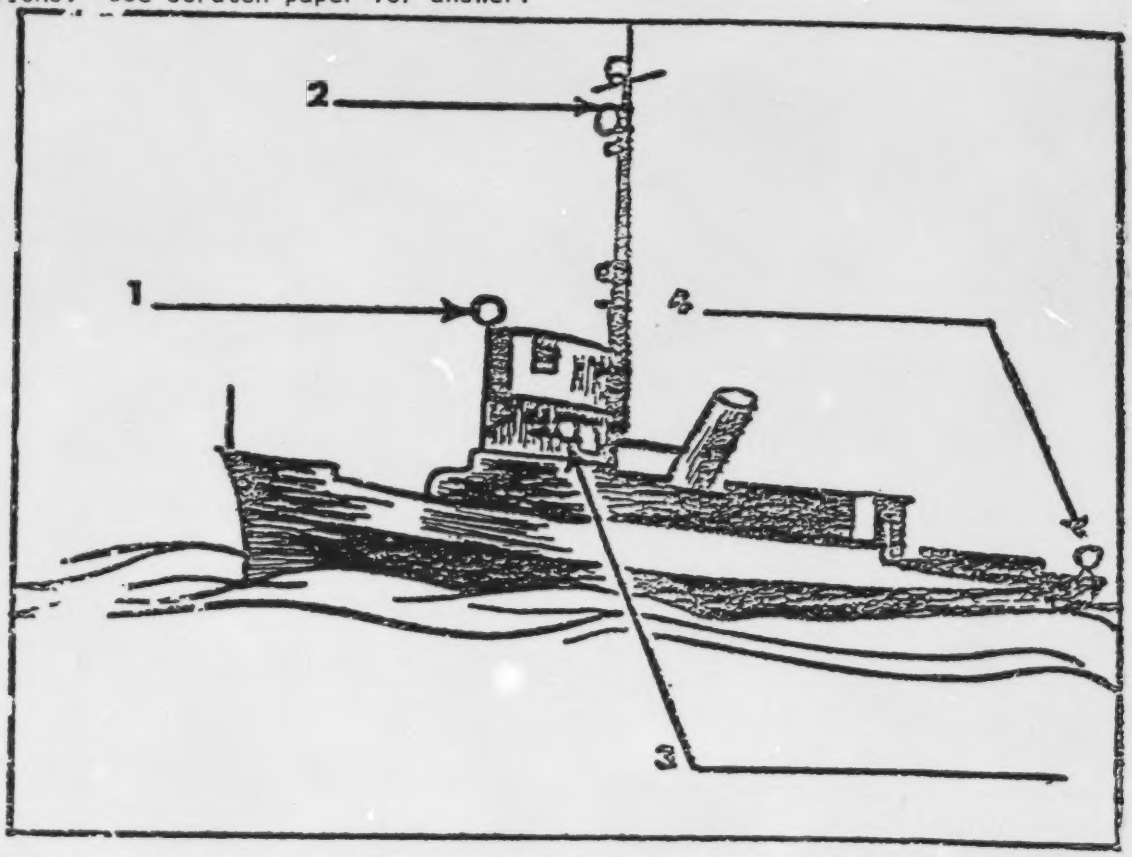
Review the material in this program and when you are ready, go to the self-test on the next page.

DO NOT WRITE IN THIS BOOKLET

SELF-TEST

DIRECTIONS: Use scratch paper for answer.

1.



Fill in the blanks provided in the illustration above with the following information:

a. Name of light.

b. Color of light.

c. Degrees of light.

2. What color is the special submarine identification light?

a. white

b. green

c. amber (yellow)

d. red

3. Running lights and special lights shall be displayed from _____ to _____.

4. A towing light should be _____ in color, and located directly above the _____ light.

5. Vessels 50 meters or more in length are required to carry how many masthead lights?

   a. 1

   b. 2

   c. 3

   d. 4

6. Visibility of sternlights should be:

   a. _____ miles for vessels less than 12 meters.

   b. _____miles for vessels 12 - 49 meters.

   c. _____miles for vessels 50 meters or more.

TURN THE PAGE FOR ANSWERS.

SELF-TEST ANSWERS

1.

1. Masthead light, white, 225°
2. Second masthead light, white, 225°
3. Sidelight, red, 112.5°
4. Sternlight, white, 135°

2. c. amber (yellow)
3. sunset, sunrise
4. yellow, stern
5. b. 2
6.

a. 2

b. 2

c. 3

APPENDIX E

EXCERPT FROM TRADITIONAL TEXT MATERIAL

EXCERPT FROM TRADITIONAL TEXT MATERIAL

The traditional text consists of one module. The objectives of the module are shown on the first page. The next four pages represent the format used throughout. The review page and the self-test are found at the end of the module.

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MODULE 9 TOPIC 2-1

QUARTERMASTER A1 COURSE

RULES OF THE ROAD LIGHTS

PROGRAMMED TEXT

OBJECTIVES

Upon completion of this programmed instruction, you will be able to:

1. IDENTIFY the running lights of ocean going vessels in the Inland Rules and vessels in the International Rules.

2. DESCRIBE what anchor lights are required by the Rules of the Road.

3. DESCRIBE when anchor, running and special lights shall be displayed.

4. STATE what rules govern special lights for fishing vessels.

5. STATE what rules govern special lights for vessels towing or being towed.

1. All Rules of the Road require vessels to display lights during established times, places and situations. What lights must be shown during what times and under what circumstances are determined by the rules under which a vessel navigates.

---

2. When, where and during what situations lights are to be displayed is defined in Navigation Rules under the section titled "Lights and Shapes." This section includes Rules 20 through 31 on pages 24 through 40. Lights required by Inland Rules are found in Articles 1 through 14 on pages 109--115. During established times under International and Inland Rules all vessels must display _____.

---

lights

---

3. Lights displayed by vessels fall into three categories and are listed as follows:

   1. Running lights.

   2. Anchor lights.

   3. Special lights.

4. The proper times for a vessel to display its lights are defined in International Rule 20 on page 24 and Inland Rules, Article 1, on page 109. Pilot Rules are on page 129 section 80.14. Read International Rule 20, Inland Article 1 and section 80.14 of Pilot Rules in CG 169 and answer the following questions.

   a. During what times must lights be displayed?

      (1) Sunrise to sunset

      (2) 1800 to 0600 each day

      (3) Sunset to sunrise

      (4) At night

   b. What rule(s) state(s) that lights shall be complied with in all weathers?

      (1) International Rules

      (2) Inland Rules

      (3) Pilot Rules

      (4) All of the above

   c. What rule(s) state(s) that lights may be exhibited from sunrise to sunset in restricted visibility?

      (1) International Rules

      (2) Inland Rules

      (3) Pilot Rules

      (4) All of the above

---

a. (3)
b. (4)
c. (1)

5. The first group of lights is known as running lights and these lights are shown while a vessel is underway. They are the masthead lights, the side lights, and the stern light. They will be covered in this order:

   a. Masthead lights

   b. Side lights

   c. Stern light

---

6. Running lights consist of the _____ lights, the _____ lights, and the _____ light.

---

masthead
side
stern

---

7. Read International Rules 21 and 22, pages 24--28 and Inland Article 2 on page 110. Also read the definition of visible on page 109.

---

8. The word visible, by Inland Rules, means "visible on a _____ _____ with a _____ atmosphere."

---

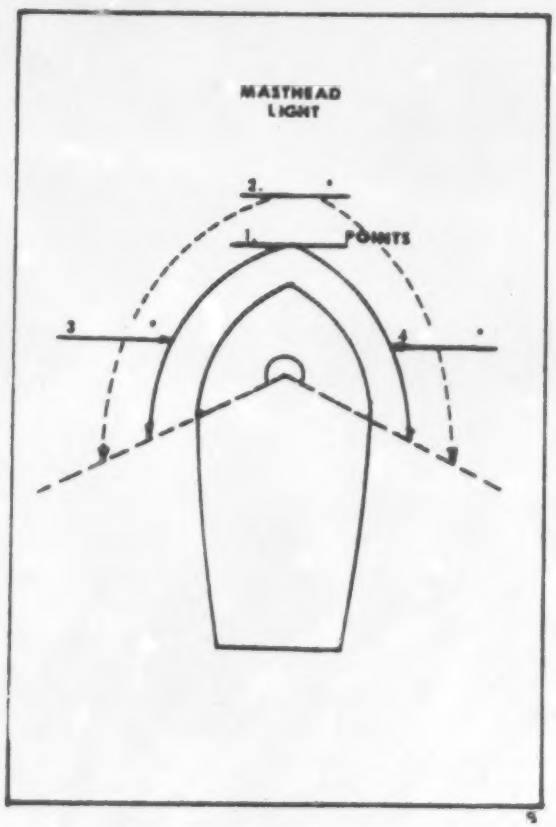
dark night
clear

9. The Rules concerning lights shall be complied with from _____ to _____.

---

sunset
sunrise

10.



In the diagram above label the four blanks with the proper answers from International Rule 21 (a) and (b) on page 24.

---

1. 20
2. 225°
3. 112.5°
4. 112 1/2°

REVIEW

In this program we have just scratched the surface of the Rules of the Road with respect to lights. You, the student, must continue to study on your own in order to have a complete understanding of lights in inland waters and on the high seas. You have the basics for a thorough understanding of this subject. Study CG-169 in your spare time until you know the rules for lights.

What is this basic understanding you have gained about lights? Let's go over what we have covered so far. There are three basic groups of lights that are displayed by vessels. They are running lights, anchor lights and special lights. Lights when required to be displayed by a vessel are displayed from sunset to sunrise. This is in all the Rules of the Road: Inland Rules, Pilot Rules and International Rules.

Running lights of some type are required of all vessels. In most cases they consist of a masthead light, side lights, stern light, and in most cases a range or second masthead light. The masthead light is a white 20-point light (225°) visible for 10 points on each side of the vessel for a distance of 5 miles. The starboard side light is a green light and the port side light is a red light. Both side lights are 10-point (112.5°) lights and shall be visible from 2 points (22 1/2°) abaft the beam on each side. The side lights shall be screened in such a manner so as to prevent these lights from being seen across the bows. Seagoing vessels of 150 feet/50 meters or greater are required to display a range or second masthead light. Smaller vessels may display a range light if they so desire. This range light is a white 20-point light similar in construction to the masthead light. In Inland Rules a nonseagoing vessel shall display a 32-point range light. A stern light is required of all vessels and shall be a white 12-point (135°) light visible at a distance of at least 2 miles.

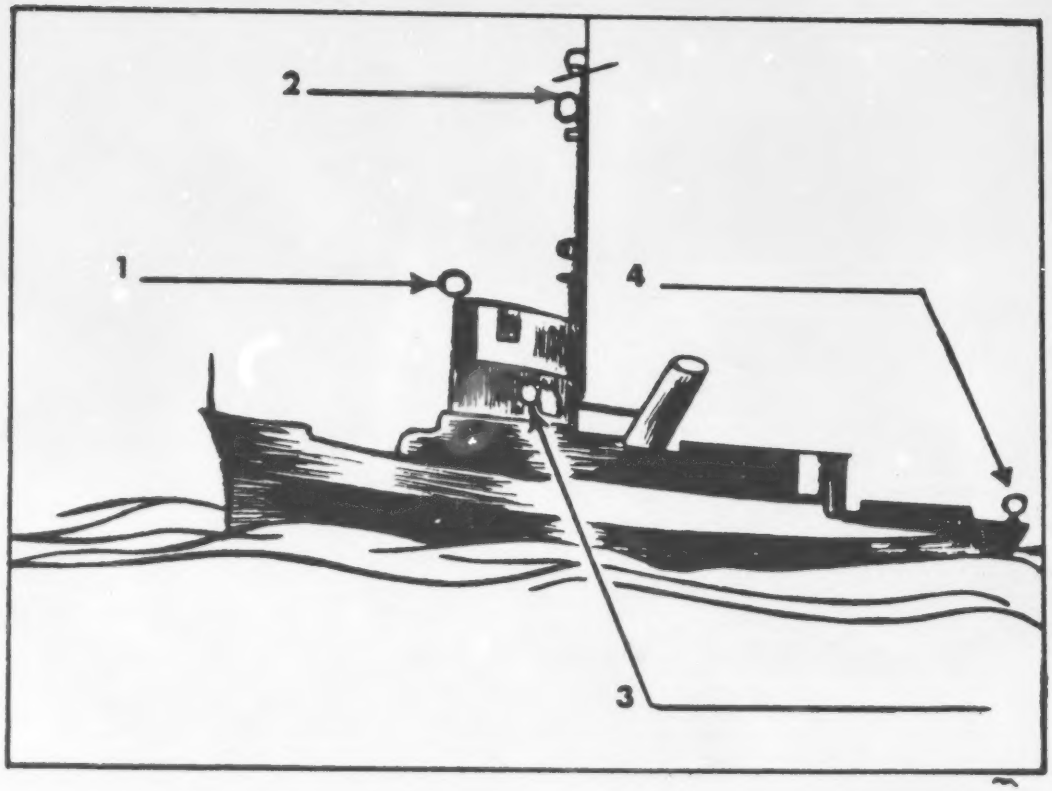
Anchor lights are required of vessels when they are not underway. Anchor lights are always 32-point (360°) lights and shall be visible at a distance of 2 miles. Vessels 150 feet/50 meters or greater carry two anchor lights: one forward, one aft. The forward anchor light shall always be higher than the after so you can tell where the vessel's bow is.

Special lights are provided for in the Rules of the Road but Inland and International Rules differ in many of their applications. The special light for submarines is an intermittent flashing all around amber light. Special lights for fishing vessels are governed by International Rule 26 and Inland Article 9. What kind of fishing and in what waters the fishing is done determines what special lights will be displayed. Vessels being towed or engaged in towing or pushing another vessel are governed by International Rule 24 and Inland Articles 3 and 5. To help you study these special lights later an outstanding reference book is Farwell's Rules of the Road and is carried by most naval ships.

Review the material contained in this program and when you are ready, go to the self-test for Rules of the Road--Lights on the next page.

SELF-TEST

1.



Fill in the blanks provided in the illustration above with the following information:

a. Name of light.
b. Color of light.
c. Degrees or points of light.

2. Vessels less than 150 feet/50 meters in length are required to carry how many anchor lights?

a. 1
b. 2
c. 3
d. 4

3. Vessels 150 feet/50 meters or greater in length carry how many anchor lights?

   a. 1
   b. 2
   c. 3
   d. 4

4. An anchor light is how many points/degrees?

   a. 10/112-1/2°
   b. 12/135°
   c. 20/225°
   d. 32/360°

5. Running lights, anchor lights, and special lights shall be displayed from _____ to _____.

6. What International Rule governs special lights for fishing vessels?

   a. 26
   b. 4
   c. 9
   d. 30

7. What Inland Articles govern special lights for vessels towing or being towed?

   a. 3 and 5
   b. 2 and 7
   c. 5 and 7
   d. 2 and 3

8. What color is the special submarine identification light?

   a. White
   b. Green
   c. Amber
   d. Red

9. Vessels engaged in special operations under International Rule 27 display 3 lights in a vertical line. Their colors from top to bottom are

   a. red, red, white.
   b. white, red, white.
   c. red, white, red.
   d. white, red, red.

Upon completion of self-test obtain answer key from learning supervisor, make correction to your self-test, notify learning supervisor of errors, and at his direction continue on to the next assignment.

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